Appendix D

Alternative Cost Estimates

Contents

COST ESTIMATE SUMMARY

WAG 7, FS COST ESTIMATES

OU7-13/14 DRAFT COMPREHENSIVE FS

INEEL - RWMC

DESCRIPTION	NO ACTION	SURFACE BARRIER	IN SITU GROUT (ISG)	IN SITU VITRIFICATION (ISV)	RETRIEVAL/ TREATMENT AND DISPOSAL (RTD)	LIMITED ACTION	FULL ENCAPSULATION
FFA/CO Management and Oversight							
WAG 7 Management	NA	26,645,000	25,645,000	68,886,000	81,977,000	12,622,000	26,645,000
Construction Management	NA	37,074,000	49,961,000	73,883,000	921,004,000	7,069,000	69,811,000
Remedial Design							
Remedial Design							
No Action	NA	NA	NA	NA	NA	NA	NA
Surface Barrier	NA	5,850,180	2,682,300	2,682,300	3,173,640	4,405,680	5,850,180
	NA	NA					
Grouting (ISG and Fdn)	NA	11,545,920	26,990,640	8,978,320	8,978,320	NA	11,545,920
ISTD/ISV	NA	4,396,240	2,202,560	62,271,100	2,753,200	NA	4,396,240
PAD A Excavation	NA	8,884,400	11,004,800	8,884,400	NA	NA	8,884,400
Retrieval/Excavation	NA	N/A	NA	NA	94,998,100	NA	NA
Vertical Slurry Wall	NA	N/A	NA	NA	NA	NA	1,462,180
Horizontal Subsurface Barri	NA	N/A	NA	NA	NA	NA	11,990,640
Readiness Assessment	NA	7,817,225	9,860,700	14,582,085	60,083,906	1,393,290	10,620,510
Remedial Action Report	NA	378,350	378,350	667,626	766,700	227,010	667,626
Remedial Action - Construction Subcontract							
Construction Subcontracts							
No Action	NA	NA	NA	NA	NA	NA	NA
Surface Barrier	NA	123,841,295	66,551,825	66,551,825	66,910,910	92,886,000	123,841,295
Grouting (ISG & Foundation	NA	182,669,860	426,789,495	141,969,685	141,969,685	NA	182,669,860
ISTD/ISV	NA	69,515,645	34,827,980	661,229,415	34,827,980	NA	69,515,645
PAD A Excavation	NA	112,987,660	139,210,720	112,987,660	0	NA	112,987,660
Retrieval/Excavation	NA	NA	NA	NA	3,980,034,080	NA	NA
Vertical Slurry Wall	NA	NA	NA	NA	NA	NA	30,616,795
Horizontal Slurry Wall	NA	NA	NA	NA	NA	NA	189,601,995
Treatability Work	NA	8,964,000	18,246,000	84,018,000	102,482,000	NA	14,710,000
TOTAL CAPITAL COST (ROUNDED)	**NA**	**598,870,000**	**804,351,000**	**1,276,390,000**	**4,889,950,000**	**118,793,000**	**857,507,000**
Remedial Action - Operations (100 Year Duration)							
WAG Post RA Management for 100 Years	3,814,350	4,099,300	4,099,300	3,484,150	3,484,150	3,783,750	4,099,000
Added Institutional Controls - For 100 Years	210,000	270,000	270,000	270,000	270,000	270,000	270,000
Cover Maintenance	NA	7,500,000	7,500,000	7,500,000	7,500,000	2,250,000	7,500,000
Surveillance and Monitoring	28,077,000	26,216,000	26,216,000	13,913,000	13,913,000	25,155,000	26,216,000
TOTAL OPERATIONS COST (100 YEARS) (ROUNDED)	**32,101,000**	**38,085,000**	**38,085,000**	**25,167,000**	**25,167,000**	**31,459,000**	**38,085,000**

PROJECT: WAG 7, FS COST ESTIMATES

OU7-13/14 DRAFT COMPREHENSIVE FS

LOCATION: INEEL - RWMC

DESCRIPTION	NO ACTION	SURFACE BARRIER	IN SITU GROUT (ISG)	IN SITU VITRIFICATION (ISV)	RETRIEVAL/ TREATMENT AND DISPOSAL (RTD)	LIMITED ACTION	FULL ENCAPSULATION
CAPITAL COST SUBTOTAL IN FY02 DOLLARS	NA	598,870,000	804,351,000	1,276,390,000	4,889,950,000	118,793,000	857,507,000
DESIGN/CONSTRUCTION (CONTINGENCY)							
No Action (20%)	NA	NA	NA	NA	NA	NA	NA
Surface Barrier (25%)	NA	32,297,869	14,808,531	14,808,531	17,521,188	24,322,920	32,297,869
ISG (35%)	NA	67,940,523	158,829,047	52,831,602	52,831,802	NA	67,940,523
ISTD/ISV (60%)	NA	36,955,893	18,515,270	355,750,258	18,790,590	NA	36,955,893
PAD A Excavation (45%)	NA	54,672,427	67,695,984	54,672,427	NA	NA	54,672,427
Retrieval/Excavation (45%)	NA	NA	NA	NA	1,833,764,481	NA	NA
Vertical Slurry Wall (25%)	NA	NA	NA	NA	NA	NA	8,017,244
Horizontal Slurry Wall (40%)	NA	NA	NA	NA	NA	NA	80,637,064
RA Report, Readiness Assessment, Treatability (30%)	NA	5,297,873	8,545,515	29,750,283	45,998,782	486,090	7,769,411
TOTAL CAPITAL COST CONTINGENCY	NA	197,060,000	268,290,000	506,710,000	1,968,900,000	24,809,010	288,190,420
Average Contingency	NA	32.9%	33.4%	39.9%	40.3%	20.9%	33.6%
TOTAL CAPITAL COST IN FY02 DOLLARS, w/CONTINGENCY	NA	795,930,000	1,072,640,000	1,786,100,000	6,858,850,000	143,602,010	1,145,697,420
TOTAL CAPITAL COST IN NET PRESENT VALUE, w/CONTINGENCY	NA	609,380,000	814,500,000	1,193,270,000	3,776,380,000	110,930,000	864,070,000
O&M COST SUBTOTAL	32,101,000	38,085,000	38,085,000	25,167,000	25,167,000	31,459,000	38,085,000
CONTINGENCY	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
TOTAL O&M COST IN FY02 DOLLARS, w/CONTINGENCY	38,520,000	45,700,000	45,700,000	30,200,000	30,200,000	37,750,000	45,700,000
TOTAL O&M COST IN NET PRESENT VALUE, w/CONTINGENCY	9,570,000	6,680,000	8,120,000	4,060,000	3,360,000	6,900,000	7,050,000
TOTAL PROJECT COST IN FY02 DOLLARS, w/CONTINGENCY	38,520,000	841,630,000	1,118,340,000	1,816,300,000	6,889,050,000	181,352,010	1,191,397,420
TOTAL PROJECT COST IN NET PRESENT VALUE, w/CONTINGENCY	9,600,000	616,100,000	822,600,000	1,197,300,000	3,779,700,000	117,800,000	871,100,000

Attachment D-1

Operable Unit 7-13/14 Feasibility Study Cost Estimate for the No Action Alternative

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost estimate are likely to occur as a result of new information and data collected during the engineering design, safety reviews, and remedial alternative. Major changes may be documented in the form of a memorandum in the administrative record file, an explanation of significant differences, or a record of decision amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within –30 to +50 percent of the actual project cost.

I. SCOPE OF WORK:

Under the No Action alternative, no additional remedial action would be taken at the Waste Area Group (WAG) 7 site beyond the current site-wide monitoring of environmental media. The buried waste would remain as they are with no containment or treatment to reduce contaminant mobility, toxicity, and volume. For this alternative, it is assumed that the perimeter fencing would be maintained and a long-term monitoring would be conducted for groundwater, soil, air, and other environmental media.

II. BASIS OF ESTIMATE:

The basis of the estimate was developed from the following sources to provide a defensible and comparative cost of the remedial alternatives. The applicable sources available for the No Action alternatives include the following:

A. EPA, 2000, "A Guide to Developing and Documenting Cost Estimates During Feasibility Study," EPA 540-R-00-002, OSWER 9355.0-75 (EPA Guidance), July 2000.

B. INEEL, 2000, "Idaho National Engineering and Environmental Laboratory Cost Estimating Guide," DOE/ID-10473, Rev. 2, January 2000

C. INEEL, 2002, "Site Craft and Professional Services Labor Rates," February 2002

D. OMB, 2002, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," Appendix C, "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses," OMB Circular A-94, February 2002.

E. R. S. Means, 2002, *Heavy Construction and Industrial Building Unit Costs Data*, 16th edition, Kingston, Massachusetts.

F. INEEL, "Analytical Laboratory Unit Costs."

III. ASSUMPTIONS:

Under the No Action alternative, the following assumptions provide the basis for the cost estimate.

A. Management and oversight

A.1 Project management for the operating and maintenance (O&M) program is 10% of the overall costs.

A.2 Reports will be prepared annually summarizing analytical and field data.

A.3 Reviews will be conducted once every 5 years for 100 years. Five-year reviews will not result in additions or modifications of the remedy. No costs are included in the estimate for remedy additions or modifications.

A.4 The estimate assumes that the INEEL site resources (i.e., Central Facilities Area [CFA], medical facilities, geotechnical lab, fire department, security, utilities at the Subsurface Disposal Area [SDA]) will be available for the duration of the project.

B. Long-Term Operating and Maintenance and Monitoring

B.1 Environmental monitoring will continue for 100 years following issuance of the record of decision (ROD). Estimated monitoring requirements are summarized in Table 1. The projected labor effort for each element of the O&M Program is provided in Table 2. The estimated costs of the required laboratory analyses are provided in Table 3.

B.2 The lysimeter analytical cost assumes that liquid samples will be recovered in 10% of the wells. Therefore, analytical costs are included only for the assumed number of recoverable samples.

B.3 A 10% allocation has been included for replacement parts and equipment for the existing wells and lysimeters.

B.4 The analytical costs are based on unit prices provided by the INEEL and do not include costs for analysis at any commercial laboratories.

B.5 Costs to either install new groundwater monitoring wells or redevelop existing wells have not been included in the cost estimate.

B.6 The No Action alternative does include costs to maintain, operate, or remove the existing organic contamination in the vadose zone (OCVZ) system.

IV. CONTINGENCY COSTS:

The EPA provides guidance for estimating contingency costs in the EPA Guidance (EPA 2000). The EPA Guidance distinguishes between scope contingency and bid contingency costs. Scope contingency costs represent risks associated with incomplete design and include contributing factors such as limited experience with technologies, additional requirements because of regulatory or policy changes, and inaccuracies in defining quantities or characteristics.
Exhibit 5-6 of the EPA Guidance provides examples of scope contingencies. Bid contingency costs are unknown costs at the time of estimate preparation and that become known as remedial action construction or O&M proceeds. Bid contingencies represent reserves for quantity overruns, modifications, change orders, and claims during construction. The EPA Guidance states that bid contingencies may be added to construction and O&M costs and typically range from 10 to 20%. A minimum contingency of 25% is assumed to be representative for the No Action alternative for this project and has been included.

V. SCHEDULE:

The environmental monitoring schedule will be as described under Section III, Assumptions. Environmental monitoring will continue at the site for 100 years.

VI. PRESENT WORTH ANALYSIS:

Present value analysis for this alternative was conducted in accordance with Chapter 4 of the EPA Guidance. The overall period of analysis for the No Action alternative will begin shortly after issuance of a ROD and continue for 100 years. Cash outflows for the No Action alternative will include payments for environmental monitoring at the levels and on the schedules identified above in Section III, Assumptions. In accordance with EPA Guidance requirements, 2002 constant dollars are used for all cash outflows.

For federal facility sites being cleaned up using Superfund authority, EPA Guidance states that it is generally appropriate to apply real discount rates found in Appendix C of OMB Circular A-94. The most current version of Appendix C of OMB Circular A-94 (revised February 2002) proposes a real discount rate of 3.9% for programs with durations longer than 30 years. The 3.9% discount rate and constant dollars are used for the present value analysis of the No Action alternative. The present value of the No Action alternative is calculated using the equations provided in EPA Guidance.

VII. RISK AND UNCERTAINTY:

The primary risk associated with the No Action alternative is that environmental monitoring will detect significant releases from the site and additional remedial actions will be required. The analyses completed for the PERA suggests it is likely that additional remedial actions eventually will be required at the site. Because of the 100-year period for this alternative, it is probable that significant regulatory changes will require additions or modifications to the environmental monitoring program. New or revised regulations might require monitoring of environmental media more frequently, or sampling and testing of environmental media for additional monitoring parameters.

VIII. TABLES

Table 1. Estimated long-term monitoring program.

Media	Monitoring Stations	Monitoring Frequency	Other Assumptions
Groundwater	16 monitoring wells	Quarterly 2 years; semiannually 3 years; annually 95 years	Maximum depth of screened interval 600 ft; four QA/QC samples per event; parameters include characteristic leaching procedure metals, nitrate/nitrite, VOCs, semivolatile organic compounds, gross alpha and beta, Sr-90, Tc-99, Np-237, U-234, U-235/236, U-238, Pu-238, Pu-239/240, Am-241, gamma isotopes, C-14, I-129, tritium, pH, turbidity, total suspended solids, and total dissolved solids.
Vadose zone	37 lysimeters	Annually in late spring for 100 years	Assume 10% of lysimeters yield adequate liquid for analysis. Assume 1 additional QA/QC sample. Samples would be analyzed for groundwater analytes.
	20 vapor ports	Quarterly 5 years; annually 95 years	Vapor port samples would be analyzed for VOCs only.
Surface water	2 locations	Every 5 years for 100 years	Surface water samples would be analyzed for groundwater analytes. Assume one additional QA/QC sample.
Air	Four CAMs	Annually for 100 years	Air samples would be analyzed for groundwater analytes.
	Site perimeter	Annually for 100 years	Radiological monitoring; requires two staff once per year, all-terrain vehicle, global position system; data plots and management for 100 years; purchase new equipment three times over 100 years.
Biological	Animal intrusion	Annually for 100 years	Requires two staff once per year.

CAM = continuous air monitor
QA/QC = quality assurance and quality control
VOC = volatile organic compound

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE NO ACTION ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

Table 2. Sampling labor requirements.

Media	Stations	Labor Effort per Event	Estimated Costs for Event
Groundwater	16 wells	2.5 personnel for staff for 8 days	\$55/hour × 200 hours = \$11,000
Vadose zone	37 lysimeters	2.5 personnel for 13 days	\$55/hour × 325 hours = \$17,875
	20 vapor ports	2.5 personnel for 20 days	\$55/hour × 500 hours = \$27,500
Surface water	Two locations	2.5 personnel for 1 day	\$55/hour × 25 hours = \$1,375
Air	Four CAMs	2 personnel for 2 days	\$55/hour × 40 hours = \$2,200
	Site perimeter	2 personnel for 2 day	\$55/hour × 40 hours = \$2,200
Biological	Animal intrusion	2 personnel for 1 day	\$55/hour × 20 hours = \$1,100

CAM = constant air monitor

Table 3. Estimated analytical requirements.

Target Analyte	Unit Cost	Groundwater Event (20 samples)	Lysimeter Event (five samples)	Surface Water Event (three samples)
Volatile organics	\$153	\$3,060	\$765	\$459
Semivolatile organics	\$295	\$5,900	\$1,475	\$885
Metals	\$525	\$10,500	\$2,625	\$1,575
Nitrate/nitrite	\$200	\$4,000	\$1,000	\$600
Gross alpha and beta	\$70.40	\$1,408	\$352	\$211
Sr-90	\$167.20	\$3,344	\$836	\$502
Tc-99	\$170.78	\$3,416	\$854	\$512
Np-237	\$230.18	\$4,604	\$1,151	\$691
U-234, -235/236, -238	\$230.18	\$4,604	\$1,151	\$691
Pu-238, -239/240	\$230.18	\$4,604	\$1,151	\$691
Am-241	\$230.18	\$4,604	\$1,151	\$691
C-14	\$105.60	\$2,112	\$528	\$317
I-129	\$105.60	\$2,112	\$528	\$317
Tritium	\$39.60	\$792	\$198	\$119
Gamma isotopes	\$178.20	\$3,564	\$891	\$535
Analytical subtotal		\$58,624	\$14,656	\$8,796
Procurement (10.42%)		\$6,109	\$1,527	\$917
Project adder[a]		\$39,294	\$9,824	\$5,894
Validation procurement		\$2,840	\$710	\$426
TOTALS		**\$106,867**	**\$26,717**	**\$16,033**

a. Adder costs included task order statement, sampling and analysis plan table, data review, data tracking, data entry (Energy Research Information System) upload, invoicing, and validation.

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE NO ACTION ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: NO ACTION ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/24/02

DESCRIPTION	MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
INSTITUTIONAL CONTROLS FOR 100 YEARS										
Replace Perimeter Security Fence	10,000	LF	$ 20	NA				$ 200,000		$ 200,000
Repair and Replace Perimeter Signs	1	LS	$ 10,000	NA				$ 10,000		$ 10,000
Subtotal										**$ 210,000**
SURVEILLANCE AND MONITORING										
Groundwater Monitoring: (16-wells)										
Groundwater Monitoring, Quarterly for 2 Years - (8-Sampling Events)	8	EVT	$ 1,000	8	EVT	$ 11,000	$ 88,000	$ 8,000	$ 854,936	$ 950,936
Groundwater Monitoring, Semi -Annually for 3 Years - (6-Sampling Events)	6	EVT	$ 1,000	6	EVT	$ 11,000	$ 66,000	$ 6,000	$ 641,202	$ 713,202
Groundwater Monitoring, Annually for 95 Years (95-Sampling Events)	95	EVT	$ 1,000	95	EVT	$ 11,000	$ 1,045,000	$ 95,000	$ 10,152,365	$ 11,292,365
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)	1	LS	$ 1,295,650					$ 1,295,650		$ 1,295,650
Vadose Zone Monitoring:										
Sample 37 Lysimeters 1 Time per Year in Late Spring	100	EVT	$ 1,000	100	EVT	$ 17,875	$ 1,787,500	$ 100,000	$ 2,671,700	$ 4,559,200
Sample & Analyze 20 Vapor Ports 4 Times per Year for 5 Years	20	EVT	$ 1,000	20	EVT	$ 27,500	$ 550,000	$ 20,000	$ 140,000	$ 710,000
Sample & Analyze 20 Vapor Ports 1 Time per Year thereafter	95	EVT	$ 1,000	95	EVT	$ 27,500	$ 2,612,500	$ 95,000	$ 665,000	$ 3,372,500
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)	1	LS	$ 864,170					$ 864,170		$ 864,170
Surface Water Monitoring:										
Collect Sample from 2 Points 2 Times Every 5 Years (20 Sample Events)	20	EVT	$ 100	20	EVT	$ 1,375	$ 27,500	$ 2,000	320,660	$ 350,160
Air Monitoring (Radiological/Organic):										
Monitor 4 Existing CAMs	100	EVT	$ 1,000	100	EVT	$ 2,200	$ 220,000	$ 100,000	$ 2,671,700	$ 2,991,700
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)	1	LS	$ 299,170					$ 299,170		$ 299,170
Perimeter Radiological Monitoring GPS with NaI Detector										
2 People, 1-Time per Year, 2 Days in Summer with Hummer & GPS	100	EVT	$ 500	100	EVT	$ 2,200	$ 220,000	$ 50,000		$ 270,000
Data Interpretation/Plot Data	100	EVT	$ 750	100	EVT	$ 2,500	$ 250,000	$ 75,000		$ 325,000
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)	1	LS	$ 59,500					$ 59,500		$ 59,500
Biological Monitoring:										
2 People 2-Events, First 5-Years for Intrusion Monitoring	NA			2	EVT	$ 1,100	$ 2,200			$ 2,200
2 People 1-Time, Every 5th Year thereafter for 95 years	NA			19	EVT	$ 1,100	$ 20,900			$ 20,900
Subtotal										**$ 28,077,000**
WAG 7 MANAGEMENT										
WAG 7 Management (@ 5% of other post-RA operations costs)							$ 1,414,350			$ 1,414,350
Annual Data Summary Report (100 reports @ 200 hrs/report)				20,000	HR	75.00	$ 1,500,000			$ 1,500,000
WAG-Wide RA 5 Year Reviews for 100 Years (20 reviews @ 600 hrs/review)				12,000	HR	75.00	$ 900,000			$ 900,000
Subtotal										**$ 3,814,350**
TOTAL COST - Post-Remedial Action Operations (100 Year Duration)										**$ 32,101,350**

Attachment D-2

Operable Unit 7-13/14 Feasibility Study Cost Estimate for the Surface Barrier Alternative

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost estimate are likely to occur as a result of new information and data collected during the engineering design, safety reviews, and remedial alternative. Major changes may be documented in the form of a memorandum in the administrative record file, an explanation of significant differences, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within –30 to +50 percent of the actual project cost.

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE SURFACE BARRIER ALTERNATIVE

Project Title:	WAG 7 OU 13/14 Feasibility Study
Estimator:	Brian K. Corb
Date:	December 2002
Estimate Type:	Planning
Reviewed/Appr:	Lee Lindig/Bruce L. Stevens

I. SCOPE OF WORK:

A. Remedial Design and Remedial Action

A.1 Construction of the Surface Barrier alternative will be implemented in two phases because a portion of the SDA is currently active and continuing to receive waste material. Phase 1 construction will cover the inactive portion of the site (105 acres) and Phase 2 construction will cover the currently active portion of the site (5 acres) after disposal operations are completed in 2020. Work associated with construction of the Surface Barrier alternative includes preconstruction activities, placement of earth fill, high-pressure in situ grouting (ISG), foundation stabilization grouting, placement of surface barrier layers, and placement of erosion control materials. Preconstruction activities will include investigation of borrow sources, preparation of final design, completion of a readiness assessment, and mobilization.

A.2 The initial construction activity will be placement of a minimum 5-ft-thick layer of earthen fill over the SDA to minimize contact with waste materials during subsequent construction activities. This layer will provide a contouring layering with an average thickness of 5 ft across the site. Before grouting activities, in situ thermal desorption (ISTD) technology will be applied to remove volatile organic compounds (VOCs) in the waste streams in pits containing the highest organic concentrations (approximately 5 acres). Grouting activities will include high-pressure ISG with specialized grout to treat waste in soil vault row (SVR) areas and the activation and fission product waste in the trenches (approximately 1,500 ft of trench). Lower pressure foundation stabilization grouting with cement-based grout will be used to stabilize waste and reduce settlement in other areas of the SDA. Concurrent with the grouting operations, the Pad A waste will be excavated and placed beneath the grading fill without treatment to reduce the vertical profile of the waste pile.

A.3 As grouting is completed, various layers of the surface barrier will be installed, including additional earth fill, gas collection, infiltration barrier, biotic barrier, filter, and topsoil layers. Placement of erosion control materials will include construction of a flood control berm around the perimeter of the surface barrier, placement of armor (riprap and other materials) on surface barrier and berm side slopes, and establishment of vegetation.

B. Long-Term Monitoring and Maintenance

B.1 Once the Remedial Action has been completed, long-term monitoring and maintenance will continue for the 100-year window with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) reviews conducted every 5 years. The long-term environmental monitoring will be conducted for groundwater, vadose zone water, surface water, and air. In addition, the surface barrier itself will be monitored annually during the first 5 years following completion of construction (beginning after the vegetation establishment period). After the completion of annual monitoring, monitoring will be reduced to every 5 years concurrent with the 5-year reviews required under CERCLA. The surface barrier will be monitored for vegetation density, erosion damage, and differential settlement. Areas of erosion damage will be repaired with additional topsoil or earth fill, and reseeded. Areas without established vegetation will be reseeded.

II. BASIS OF ESTIMATE:

The basis of the estimate was developed from the following sources to provide a defensible and comparative cost of the remedial alternatives. The applicable sources available for the Surface Barrier alternatives include:

A. EPA, 2000, "A Guide to Developing and Documenting Cost Estimates During Feasibility Study," EPA 540-R-00-002, OSWER 9355.0-75, (EPA Guidance), July 2000

B. INEEL, "Cost Estimating Guide," DOE/ID-10473, September 2000

C. DOE, 1997, "Environmental Assessment and Plan for New Silt/Clay Source Development and Use at the Idaho National Engineering and Environmental Laboratory," DOE/EA-1083, May 1997

D. Caterpillar, Inc., 2001, "Caterpillar Performance Handbook," 32nd Edition, Peoria, IL

E. The INEEL Site Stabilization Agreement, Union Labor Agreement

F. Facilities Unit Costs—Military Construction, PAX Newsletter No. 3.2.2—10, March 2000

G. INEEL CERCLA Disposal Facility (ICDF) Construction Cost Estimate, Cap Construction Cost (CH2MHILL, December 2000)

H. Subject Matter Experts—M. Jackson, BBWI, and T. Borschel, BBWI, "Availability of Borrow Source Material at the INEEL"

I. BBWI, "INEEL Site Craft and Professional Services Labor Rates," February 2002

J. OMB, 2002, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," Appendix C, "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses," OMB Circular A-94, February 2002.

K. AMEC Earth & Environmental, Inc., ISV Technology Specialist

L. R. S. Means, 2002, *Heavy Construction and Industrial Building Unit Costs Data* 16th edition, Kingston, Massachusetts.

M. INEEL "Analytical Laboratory Unit Costs."

III. ASSUMPTIONS

The primary work associated with the Surface Barrier alternative includes placement of a surface barrier over the SDA. Because some portions of the SDA will continue operating until 2020, the construction effort is divided into two phases. Phase 1 construction includes placing a surface barrier over approximately 105 acres of inactive portions of the SDA. Phase 2 construction includes placing a surface barrier over an estimated 5 acres of the SDA that will remain active until 2020. Specific elements of the work and important assumptions are provided below:

A. Management and Oversight

A.1 Project Management for the BBWI oversight of this alternative has been estimated based on an average classification of job categories using the BBWI rates. The number of full-time equivalents (FTEs) are based on 2,000 MH per person per year.

A.2 The remedial design and remedial action (RD/RA) schedule assumes that the budgetary funding will not be constrained.

A.3 The RD/RA schedule assumes that no unexpected delays will result from changes to the unreviewed safety question and safety assurance review (USQ/SAR) process.

A.4 The estimate assumes that the INEEL site resources (i.e., CFA, medical facilities, geotechnical lab, fire department, security, utilities at the SDA) will be available for the duration of the project.

B. Design and Preconstruction

B.1 Preconstruction activities—Borrow source investigations, cultural resource clearance, and development of an onsite source of basalt rock, final design, readiness assessment completion, road building, and mobilization.

B.2 Treatability testing for ISG sand ISTD will be conducted.

C. Site Preparation and Support Activities and Facilities

C.1 Placement of initial earth fill—Site clearing, grubbing, and leveling will be followed by placement of a 5-ft-thick cover over areas to be grouted.

C.2 All existing wells and lysimeters within the footprint of the SDA will be plugged and abandoned.

C.3 Containment buildings and structures will be constructed (see ISG alternative cost estimate for more information).

C.4 In situ thermal desorption—ISTD will be performed to remove VOCs in the high organic concentration waste streams in the pits before grouting operations. The ISTD technology will be applied over a surface area of 5 acres, to a depth of 14 ft.

C.5 In situ grouting—The SVRs and the activation and fission product waste streams in the trenches will be treated by high-pressure jet grouting.

C.6 Pad A excavation—Approximately 10,000 m^3 of waste at Pad A will be excavated, sorted, and (depending on the integrity of the containers) either overpacked or placed in new containers. The containers will then be placed in a single layer within the central portion of the SDA and covered by the surface barrier.

C.7 Foundation stabilization grouting—Wastes will be stabilized to reduce settlement by low-pressure grouting areas of pits and trenches with cement-based grout. It is assumed that once the foundation grouting has been completed, heavy equipment operation can commence without any ground subsidence. No additional costs for cribbing or temporary road stabilization are included in the estimate.

C.8 Placement of earthen fill and gravel gas collection layers—An initial earthen fill (10-ft-average thickness) will be placed over the SDA to grade the site for surface barrier construction. Six inches of gravel will be placed to collect gas that may be generated beneath the surface barrier.

C.9 During the development of this cost estimate, modular containment buildings were evaluated including Butler and Sprung structures. The cost of a building for the ISG operation considers a Sprung-type containment structure for the operation. The costs for these facilities include fire protection; heating, ventilation, and air conditioning; lighting; communication lines; and power distribution.

D. Borrow Areas

D.1 To use Spreading Area B as a borrow source, the area will need to be drilled and tested for material quality and quantity. For this PERA, it is assumed that an Environmental Assessment Plan will need to be revised; an Army Corps of Engineers Section 404 permit will need to be obtained, and a National Pollutant Discharge Elimination System permit will need to be completed and approved prior to using this area. It is assumed that the permitting process for Spreading Area B will be completed concurrent with other preconstruction activities to avoid extending the construction schedule.

D.2 Spreading Area B will be available and will not be flooded. No additional costs have been provided to dewater Spreading Area B.

D.3 An adequate quantity and quality of borrow source material is available from Spreading Area B, the Borax Pit, and the Basalt Source (for riprap and coarse fractured material). Furthermore, no royalty fee or earthen material costs are provided for in the estimate.

D.4 An adequate water source will be available to support the earthmoving and soil moisture conditioning for placement and compaction based on the equipment productivities developed for this estimate.

D.5 The source of low-permeability soil will meet the hydraulic conductivity requirements of 10^{-7} cm/second and the soil will not require amendment with bentonite.

E. Treatability Testing Assumptions

E.1 Additional characterization of the SDA and treatability testing using both simulated and actual waste locations will be required to establish the design and safety basis for operating ISTD, ISG, and the secondary waste treatment processes for processing waste generated in the ISTD off-gas cleanup systems. This work will verify that waste sites and properties that represent bounding conditions can be safely and effectively treated.

F. Surface Barrier Construction

F.1 Placement of clay, geomembrane, and filter layers—A 2-ft-thick compacted clay layer and a 60-mil high-density polyethylene (HDPE) geomembrane layer will be placed as infiltration barriers. A 1-ft-thick filter section consisting of sand and gravel will be placed over the geomembrane.

F.2 Placement of remaining surface barrier layers—Remaining surface barrier layers will consist of a 2.5-ft-thick layer of coarse fractured basalt (biotic barrier layer), 1-ft-thick filter layer consisting of sand and gravel, 8-ft-thick layer of engineered earth fill, and a 1-ft-thick layer of topsoil.

F.3 Placement of perimeter berm and erosion controls—A 6-ft-high berm will be constructed around the perimeter of the surface barrier to control flooding; filter layers, coarse fractured basalt, and riprap will be placed on the side slopes to minimize erosion.

F.4 Vegetation establishment—The topsoil layer will be seeded with native grasses to provide a vegetative cover. The cover will be monitored and reseeded as necessary to maintain the vegetative layer.

G. Organic Area Treatment with In Situ Thermal Desorbtion

G.1 In situ thermal desorption will be used to treat the high VOC area waste streams in the SDA to minimize future operational requirements on the OCVZ system. ISTD will employ an array of heated stainless steel pipe assemblies inserted into the ground on an 8 × 8-ft spacing to a depth of approximately 3 ft below the buried waste.

G.2 It is assumed that each pipe assembly will include a sealed pipe that contains an electrical-resistance heating element, a vented pipe used to extract gases, and thermocouples. Extraction pipes will be connected to a pipe manifold that conveys the gases to an off-gas treatment system. The average pipe assembly will be inserted to a depth of 24 ft. Pipe assemblies will be inserted into the ground using either nonstandard vibratory or hydraulic techniques.

G.3 It is assumed that heat can be transferred from the heating elements to the pipes and then to the waste at a nominal rate of 350 watts per lineal ft of heated pipe.

G.4 Six ISTD systems will be used. With the 8 × 8-ft spacing of the pipe assemblies, heating will occur over an approximate 90-day period. The six systems are projected to treat approximately 2 acres per year, requiring 2.5 years to complete the projected 5 acres.

G.5 The ISTD systems will require about 330 kW.

G.6 When a subsystem reaches its heating objectives, the pipe manifold that collects off-gases will be isolated from the rest of the off-gas manifold by closing valves. The 12 or 20 extraction pipes in the subsystem will be crimped closed, the manifold section will be disconnected and transported to the front of the advancing ISTD system and reconnected after purging at that location.

H. Pad A Waste Retrieval And Management

H.1 It is assumed that 6 m^3 of transuranic (TRU) waste will be generated during the retrieval actions, which will require off-Site disposal at the Waste Isolation Pilot Plant (WIPP).

H.2 The Pad A retrieval operations will require a primary and secondary containment structure, approximately 230 × 410 ft in plan dimensions, and designed in accordance with the International Building Code (IBC). Frost depth for building foundations is 5 ft (DOE-ID 2001). The ground snow load of at least 35 lb/ft^2 shall be used in American Society of Civil Engineers (ASCE) 7 calculations and a minimum roof snow load of 30 lb/ft^2 shall be used for all buildings (DOE-ID 2001). Retrieval buildings and other structures shall not be designed to tornado loads (DOE-ID 2001). All structures shall be designed to performance category (PC) 2 standards for wind, seismic, and flood design requirements. The Performance Category (PC) 2 seismic return period is 1,000 years (STD-1020). The fastest wind speed for INEEL structures is 70 mph, and 3-second gust wind speed is 90 mph (DOE-ID 2001). The design mean hazard annual probability for floods is 5×10^{-4}, or a 2,000-year return period (STD-1020). Fire protection systems shall meet or exceed the minimum requirements established by the National Fire Protection Association and DOE O 420.1.

H.3 The primary and secondary containment structure is a double-walled structure that would be equipped with radiation alarm systems such as constant air monitors set to alarm when airborne contamination reached unacceptable levels. Criticality alarms would be installed in the primary containment structure. These alarm systems would require periodic testing and calibration.

H.4 It is assumed that the containment building will be dismantled and buried beneath the surface barrier. A cost allowance of 25% of the capital expenditures of the building costs is assumed to be representative of the estimated level of effort to dispose of the buildings and equipment.

H.5 The structure would include a gantry crane that would be used to apply water, foams, and foggers to keep dust and contamination at a minimum during the retrieval operation. The crane would provide support for lifters, detectors, and other equipment.

H.6 Negative pressure would be applied to the digface at all times and directed to high-efficiency particulate air (HEPA) filters to control the contamination and keep it from entering the secondary containment structure. Air exhausted from the retrieval zone would be fully saturated with water vapor by applying mists to control airborne contamination. Some of the water vapor would condense in the ductwork leading to the air treatment system. This condensate would be recycled through the retrieval-face misting system, as would other condensates. The air treatment system consists of chillers, demisters, heaters, and banks of HEPA filters in two parallel systems to provide redundancy if one of the systems failed. The chillers would cool the air and decrease the air's dew point, causing mists to form. The air would then pass through a demister, which would remove moisture from the air. The air would then pass through heating elements to raise the temperature to about 10°C above the dew point. The air would then pass through the HEPA filters.

I. ISG/Foundation Grouting Assumptions

I.1 The ISG equipment and enclosures will be dismantled and disposed of under the Surface Barrier Cap. Twenty-five percent of the capital equipment expenditure is included in the estimate for the deactivation, decontamination, and decommissioning (D&D&D) of the equipment.

I.2 The TRU pits and other trenches will be only low-pressure grouted for foundation stabilization.

I.3 Grouting operations will be conducted within a weather enclosure to facilitate Radiological Control. Two sprung-type structures will be moved to the site. These structures initially will be constructed and then progressively disassembled and reconstructed to accommodate the advancement of the ISG operation. Following completion of the grouting operation within an enclosure and before disassembly of the building, the grouted area will be covered with a minimum of two ft of earth fill.

I.4 The grout production rate of one hole every 4 minutes can be maintained with no subsurface anomalies that would further reduce the assumed efficiency of 70%. ISG will begin after the f initial earthen fill has been placed over a significant portion of grouting areas. ISG for waste treatment will be performed using the same grouting technique and grout types as described for the ISG alternative, however, ISG will be limited to the SVRs and portions of the waste trenches. Specific assumptions related to ISG are provided in the ISG alternative cost estimate.

I.5 The SVRs and other trenches will be treated using the ISG technology and based on a 2-ft center-to-center spacing. The productivity assumption is grouting of one hole every 4 minutes.

I.6 Foundation stabilization grouting will be applied using low-pressure jet grouting technology and based on a 4-ft center-to-center spacing. The productivity assumption is grouting of one hole every 4 minutes.

I.7 Grouting for foundation stabilization will be performed using a modified drill rig to inject grout under high pressures into the waste stream. The grout will fill readily accessible void space and cure into a solid monolith. This technique allows using a relatively low-cost cement-based grout instead of specialized grout types for waste treatment. Unlike the ISG portion of the alternative, the foundation stabilization operation would not be required to completely mix the grout with the waste or soil. It is assumed that voids that could threaten the integrity of the surface barrier are fairly large and would be intersected if the spacing between grout holes were larger than the spacing for ISG. In addition, it is assumed that substantially less grout would be needed for foundation stabilization because the grout would be injected on a less dense spacing, and that an attempt was made to compact waste when it was initially placed in the SDA. Assumptions for foundation stabilization grouting for the Surface Barrier are addressed in the ISG alternative cost estimate.

I.8 The equipment and crew size needed for ISG and foundation stabilization grouting is similar to the crew size and equipment needed for the ISG alternative.

I.9 Remaining earthen fill and the gravel gas collection layer of the surface barrier will be placed during grouting activities.

J. Capital Costs, Unit Rates, and other Pricing Assumptions

J.1 The unit prices have been developed from a crew build-up to process, load, haul, place, and compact basis. The volume of material represented in the cost tables identifies compacted cubic yards (CCY). The appropriate factors convert the estimated unit material weights (e.g., bank, loose, and fill) and are factored into the equipment productivity.

J.2 Crew labor rates were developed based on hourly rates stipulated in the INEEL Site Stabilization Agreement. Labor and equipment spreads were developed to support the project schedule based on the assumed achievable daily productivity. Other factors that influenced the selection of labor and equipment quantities include safety considerations, level of personal protective equipment (PPE) of the work to be performed, haul routes, and availability of resources on the INEEL. Each daily crew cost also includes field oversight personnel such as the health and safety officer (HSO), superintendents, foremen, certified industrial hygienists (CIHs), maintenance personnel, and allocation of supplies (e.g., fuel, oil, grease, and spare parts).

J.3 Mobilization and demobilization charges are based on 2% of the total cost for each phase.

J.4 Capital equipment and pricing were selected from commercially available sources or similar projects allowing a scale factor to be applied to yield an estimated cost of the conceptual equipment and operational requirements. Equipment installation cost is considered to be a significant variable in estimating individual components of a given system. The installation cost of the capital equipment was based on a percentage of the capital costs ranging from 110 to 160% of the estimated capital expenditure based on the unknowns and level-of-complexity.

J.5 Subcontractors bond and insurance rate of 2% of the total subcontractor dollars including overhead and profit has been included based on each alternative.

J.6 The estimate includes an allocation for the INEEL specific work order procedure requirements and safety meetings. Because this estimate includes primarily unit prices, the labor cost is estimated to be 40% of the unit prices and, based on historical data, cost of the INEEL-specific process is approximately 6% of the total labor dollars.

K. Schedule

K.1 The estimate assumes that earthwork operations can be performed for 10 months per year without weather impacts. The work will be performed working two 10-hour shifts, with a back shift performing maintenance 5 days per week.

K.2 The estimate assumes that the field crews will demobilize the equipment during the 2-month winter shutdown period to refurbish and replace the equipment. The estimate includes an allocation to cover these costs in addition to the 2% estimated.

L. Health and Safety

L.1 Once the initial site grading material is placed over the SDA, all earthmoving operations can be performed in Level D PPE.

L.2 Pad A waste will be excavated, sorted, and either overpacked or placed in new containers. The containers then will be tightly stacked in a single layer within the SDA and covered by the cap grade fill. The estimate assumes that this waste will not require any treatment and will be performed in Level B PPE.

M. Long-term Operating and Maintenance and Monitoring

M.1 The monitoring program will be the same as for the No Action alternative (see Section D-1).

M.2 The capital cost for the project includes replacing the groundwater wells and lysimeters that were removed as part of site preparation. The estimate assumes that nested wells and lysimeters will be installed at varying depths of 20 ft, 90 ft, 200 ft, and 600 ft along the interbed surfaces.

M.3 The lysimeter analytical cost assumes that liquid samples will be recovered in 10% of the wells. Therefore, analytical costs are included only for the assumed number of recoverable samples.

M.4 After topsoil has been placed as the final layer on the surface barrier, it will be seeded with native grasses to provide vegetative cover that will reduce erosion. However, because of the arid climate of the INEEL, an extended period of time will be required to establish a permanent vegetative cover. Erosion of the uppermost layers of the surface barrier during snowmelt will occur during the years immediately following construction and repairs, and reseeding will be required.

M.5 Ongoing maintenance of the surface barrier will be required in perpetuity after construction is completed. It is assumed that frequent maintenance will be required during the years immediately following construction, to repair damage from erosion and to establish a permanent vegetative cover. In addition, the added weight of the surface barrier is expected to result in increased settlement during the initial years following construction. Some areas of the surface barrier will require ongoing maintenance to repair damage resulting from settlement. It is expected that annual maintenance and repairs will be required during the first 5 years following construction. Ongoing maintenance and repairs will continue every 5 years concurrent with the 5-year review process.

N. Design Costs

The following discussion provides the basis for the assumed percentage for design, construction, and contingency. The EPA provides guidance for estimating remedial design costs in the EPA Guidance (EPA 2000). Exhibit 5-8 of the EPA Guidance provides examples of remedial design costs as a percentage of total capital costs. The percentages range from 20% for projects with capital costs less than $100,000 to 6% for projects with capital costs greater than $10 million. The EPA Guidance does not provide an example of design costs that vary according to the complexity of technologies.

For the WAG 7 PERA, the alternatives include technologies that have been demonstrated on other sites and have well-developed engineering design criteria (e.g., capping) and technologies that have not been demonstrated on a large scale and require development of engineering design criteria (e.g., ISV). For the WAG 7 PERA alternatives, remedial design costs are expected to vary significantly according to the degree of complexity and the estimated costs for remedial design need to reflect the varying degrees of complexity. Based on the complexity of the technology application, a percentage of the capital and operating cost specific to the technology was assumed.

The proposed cover system has been demonstrated on other sites and design standards have been developed for the various types of materials and construction methods. Some borrow source investigations will be needed to verify material properties and quantities, but the methods for conducting these investigations are not expected to require specialized equipment or personnel. Because capping is a demonstrated technology with established design standards, the cost for remedial design is assumed to be 6% of capital costs.

In situ grouting includes subsurface jet injection of specialized types of grout into waste disposal areas of the SDA to stabilize and treat waste materials. ISG will need to be done inside a modular building to contain possible releases of contaminants. Some waste disposal areas will require pretreatment before grouting. Considerable effort will be needed to design appropriate grout types for the waste disposal areas, design the modular building and grouting equipment, determine areas of the site that will need pretreatment, and field test the various design elements. Because of the additional design effort required for ISG, the cost for remedial design is assumed to be 8% of capital costs.

Foundation stabilization grouting includes using modified grouting equipment to jet grout areas of the SDA to fill voids within the waste and provide a stable foundation for placing and maintaining cover systems. Foundation grouting is somewhat similar to ISG except specialized grout and grouting equipment (including a modular building) will not be needed and the grout holes will be spaced farther apart than for ISG. Cement-based grout and modified grouting equipment will be used for this technology. Some field demonstrations will be conducted to verify the ability of the grouting equipment to penetrate the waste disposal areas and to estimate the approximate quantity of grout that will be needed. Because the design effort will be considerably less for foundation grouting than for ISG, the cost for remedial design is assumed to be 7% of capital costs.

The various technologies and the percentage of capital costs estimated for remedial design are summarized in Table 1. These percentages are applied to individual technologies in the cost estimate to establish estimated design costs for the various alternatives.

O. Construction Management Costs

Cost considerations for BBWI oversight, regulatory agency interaction, and project management were estimated on a representative basis of an assumed level of effort required to implement the selected alternative. Additionally, costs for the remedial design, safety equipment and PPE, construction management, general conditions, and insurance and bonds were included in the estimate to capture a relative basis for cost comparison and to identify other costs associated with implementing a given remedial alternative.

The percentage basis assumed for each category identified was selected considering the complexity of the alternative and risk and uncertainty of the approach. The cost captured in conjunction with the percentage basis identified under the category general conditions includes administration buildings, parking area, utilities, and support infrastructure to facilitate the remedial alternative.

P. Contingency Costs

The EPA provides guidance for estimating contingency costs in the EPA Guidance, which distinguishes between scope contingency and bid contingency costs. Scope contingency costs represent risks associated with incomplete design and include contributing factors (e.g., limited experience with technologies, additional requirements because of regulatory or policy changes, and inaccuracies in defining quantities or characteristics). Exhibit 5-6 of the EPA Guidance provides examples of scope contingencies. Bid contingency costs are unknown costs at the time of estimate preparation, which become known as remedial action construction or O&M proceeds. Bid contingencies represent reserves for quantity overruns, modifications, change orders, and claims during construction. The EPA Guidance states that bid contingencies may be added to construction and O&M costs and typically range from 10 to 20%.

Because EPA Guidance suggests that contingency costs will vary according to the alternative technologies, it is necessary to estimate varying contingency costs for the technologies included in the alternatives of the WAG 7 PERA. Technologies have been evaluated separately to determine appropriate contingency costs. Scope and bid contingencies for each technology associated with this alternative are discussed below and are shown only in the summary cost estimate that lists the comparative cost of each alternative.

The cover system includes using several types of materials in addition to those planned for biotic barrier technology, constructing of infiltration barriers, and using synthetic materials. One significant assumption for this technology is that available native materials will be capable of meeting infiltration barrier layer permeability requirements without using additives (e.g., bentonite). Capping technology is assumed to require a scope contingency within the range of 10 to 20% as shown in Table 2. Because of the risk associated with the need for additional borrow sources for materials, using synthetic materials, and the possible need to use additives for infiltration barrier layer construction, the cost for the scope contingency is assumed to be 15%. Most risks associated with capping technology will be significantly reduced during remedial design, therefore, the cost for the bid contingency is assumed to be 10%. The total contingency for capping technology is assumed to be 25% of capital costs.

ISG includes jet injection of various types of grout into waste materials in the SDA to stabilize and treat waste materials. ISG technology will require consideration of appropriate grout design, design of specialized grouting equipment and a modular containment building, and field demonstrations. ISG technology is assumed to require a scope contingency within the range of 15 to 35% as shown in Table 3. Because of the specialized design efforts required for this technology, the cost for the scope contingency is assumed to be 20%. Some significant construction risks still will be associated with this technology because of unanticipated subsurface conditions, therefore the cost for the bid contingency is assumed to be 15%. The total contingency for ISG technology is assumed to be 35% of capital costs.

Foundation stabilization grouting includes lower-pressure grouting areas of the SDA with cement-based grout to fill voids within the waste and provide a stable foundation for placing and maintaining cover systems. While foundation stabilization grouting is somewhat similar to ISG, design of specialized types of grout and a modular containment building will not be required. Scope and bid contingencies for foundation stabilization grouting are the same as those for ISG (20% and 15%, respectively) with a total contingency for foundation grouting assumed to be 35% of capital costs.

The scope and bid contingency percentages associated with this alternative are identified in Table 3. These percentages are applied to individual technologies in the cost estimate to establish a representative aggregate cost contingency.

Considering the cost contingency guidance provided in Table 2 for each of the technologies, a representative contingency was selected within the range provided, factoring in complexity and size of the project, and inherent uncertainties related to the remedial technology. However, the guidance document does not address all of the remedial technologies identified in this alternative. Specifically, the foundation stabilization grouting and ISG technologieswould be within a cost contingency range of 20 to 35% and are considered representative for this work and project scope.

IV. SCHEDULE:

The following activities comprise the RD/RA portion of the Surface Barrier alternative. The corresponding durations are based on the estimated crew productivity, regulatory reviews and approvals, and weather constraints inherent to the INEEL site. Tables 4 and 5 show this information.

V. PRESENT WORTH ANALYSIS:

Guidance for present value analysis is provided in Chapter 4 of the EPA Guidance (EPA 2000). EPA Guidance states that the present value analysis of a remedial alternative involves four basic steps:

1. Define the period of analysis

2. Calculate the cash outflows (payments) for each year of the project

3. Select a discount rate to use in the present value calculation

4. Calculate the present value.

Periods of analysis for the Surface Barrier alternative include Phase 1 design and construction, Phase 2 design and construction, and O&M. The Phase 1 design and construction period is estimated to occur during a 12.5-year period beginning shortly after issuance of a ROD for the site. Phase 2 design and construction is estimated to occur during a 5.5-year period beginning shortly after currently active areas of the site are closed in 2020. The O&M period will begin toward the end of the vegetation establishment period for Phase 1 construction and will continue for 100 years.

Cash outflows for the Surface Barrier alternative will include payments for design and construction, periodic payments for major repairs, and annual O&M costs. The EPA Guidance suggests that most capital costs should be assumed to occur in the first year of remedial action when funds are committed for remedial action. While this suggestion might be a realistic assumption for short-duration remedial actions, it is not a realistic assumption for the Surface Barrier alternative because of time required for design and construction. Cash outflows for the surface barrierwould be paid on an annual basis as costs are incurred, beginning with the borrow source investigation/remedial design and ending with the end of the vegetation establishment periods for Phase 1 and Phase 2 construction.

Annual capital cost payments vary with the level of activity, with relatively low annual payments during the borrow source investigation, remedial design, readiness assessment, and vegetation establishment periods, and relatively high annual payments during heavy construction periods (grouting and material excavation, processing, stockpiling, and placement). Periodic costs for major repairs would occur every 5 years concurrent with the 5-year reviews required by CERCLA. Periodic costs would begin 5 years after Phase 1 construction and continue through the O&M period. Annual O&M costs would begin the first year after completion of Phase 1 construction and continue for 100 years. In accordance with EPA Guidance requirements, 2002 constant dollars are used for all annual and periodic cash outflows.

EPA Guidance requires using a real discount rate that approximates the marginal pretax rate of return on an average investment and has been adjusted to eliminate the effect of expected inflation. The real discount rate must be used with constant or real dollars that have not been adjusted for inflation. EPA Guidance recommends using a 7% real discount rate for present value analysis in most remedial action cost estimates. However, for federal facility sites being cleaned up using Superfund authority, EPA Guidance states that it is generally appropriate to apply the real discount rates found in Appendix C of OMB Circular A-94. The suggested rates for federal facility sites are based on interest rates from Treasury notes and bonds and are appropriate because the federal government has a different cost of capital than the private sector. The most current version of Appendix C of OMB Circular A-94 (revised February 2002) proposes a real discount rate of 3.9% for programs with durations longer than 30 years. The 3.9% discount rate and constant dollars are used for the present value analysis of the Surface Barrier alternative. The present value of the Surface Barrier alternative is calculated using equations provided in EPA Guidance.

VI. RISK AND UNCERTAINTY:

Because the primary construction activity associated with the Surface Barrier alternative is excavation, hauling, and placing of very large quantities of borrow material, the highest risk for this alternative is any other situation that results in losing using a primary borrow source located close to the site. The largest quantity of material needed for the surface barrier is silt loam. For this alternative, it is assumed that sufficient quantities of silt loam will be available from Spreading Areas A and B, located near the site. If these sources are lacking in capacity or otherwise unavailable, the nearest alternative sources are the Ryegrass Flats and the Water Reactor Research Test Facility (WRRTF) borrow areas, located 12 and 34 mi from the site, respectively. Haul distances from the spreading areas are 1.5 mi from Spreading Area A and 1 mi from Spreading Area B. Increased haul distances could significantly increase the cost of materials and delay construction.

Another significant risk is the general assumptions that have been made concerning the areas of the site that will need to be grouted, the estimated grout uptake by the waste, and the grouting production and the foundation stabilization rates. None of these assumptions have been verified by tests using the proposed grouting equipment in onsite waste pits, trenches, or soil vaults. Quantities of materials and the schedule for grouting could deviate significantly from the quantities and production rates assumed for this PERA.

Assumptions regarding the quality of material available for the surface barrier may be found invalid during borrow source investigations. Compacted clay from Spreading Area B is assumed to be capable of meeting project specifications without the need for additives. If low-permeability requirements cannot be met by using the native material, bentonite will need to be added to the material to reduce permeability. However, the quantity of bentonite needed would probably be low (approximately 5%) and the addition of bentonite would reduce the compactive effort needed during placement to achieve the specified permeability. The additional time required for adding bentonite to the material could extend the project schedule.

VII. ESTIMATED MATERIAL VOLUME:

Tables 6 and 7 summarize the required materials for the Surface Barrier alternative and related design layers, thickness, and volume.

VIII. TABLES:

Table 1. Summary of remedial design costs as percentages of capital and operating costs.

Technology	Percentage of Capital and Operating Costs
Capping (Surface Barrier)	6
In situ thermal desorption	8
In situ grouting	8
Pad A Retrieval	10

Table 2. Example feasibility study-level scope contingency percentages.

Remedial Technology	Scope Contingency (%)
Soil excavation	15 to 55
Synthetic cap	10 to 20
Clay cap	5 to 10
Surface grading and diking	5 to 10
Revegetation	5 to 10

Table 3. Summary of contingency costs as percentages of capital costs.

Remedial Technology	Percent of Capital Cost		
	Scope Contingency	Bid Contingency	Total Contingency
Capping	15	10	25
In situ thermal desorption	25	25	50
In situ grouting	20	15	35
Foundation stabilization grouting	20	15	35

Table 4. Phase 1—Design and construction.

Activity Description	Estimated Duration
Borrow source investigation	1 year
Remedial design and procurement	1.5 years (overlaps borrow source inv. by 0.5 year)
Readiness assessment	1 year (no overlap with design)
Mobilization	0.5 year (no overlap with readiness assessment)
Initial earthen fill placement	1 year (no overlap with mobilization)
Foundation and in situ grouting	6 years (overlaps earth-fill placement by 1.0 year)
In situ thermal desorption	2.5 years (overlaps with grouting operation)
Pad A waste excavation and placement	2 years (overlaps with grouting operations)
Grading fill and gravel placement	1 year (overlaps grouting by 1.0 year)
Clay, geomembrane, and filter layers	1 year (overlaps grading fill placement by 0.5 year)
Placement of remaining layers	1 year (overlaps clay, geomembrane, and filter by 0.5 year)
Vegetation establishment	2 years (no overlap with placement of remaining layers)

Table 5. Phase 2—Design and construction.

Activity Description	Estimated Duration
Remedial design and procurement	1 year assumed
Readiness assessment	1 year (no overlap with design)
Mobilization	0.5 year (no overlap with readiness)
Grouting and cover system construction	1 year (no overlap with mobilization)
Vegetation establishment	2 years (no overlap with grouting and cover system)

Table 6. Distances and sources of borrow materials for the modified Resource Conservation and Recovery Act Subtitle C cover system.

Material	Issue	One-Way Haul Distance	Source
Topsoil	This material would consist of organic silt loam and would be used to construct a topsoil layer to support vegetation on top of the surface barrier.	1.5 mi	This material is assumed to be unprocessed organic silt loam derived from Spreading Area A.
Silt loam	This material would be used to construct a number of the layers within the cap including the general site grading fill, perimeter berm, and engineered earth fill.	1.5 mi	The majority of this material is expected to be unprocessed silt loam derived from Spreading Area B. Additional material is available from Ryegrass Flats (haul distance = 12 mi) and the WRRTF borrow area (haul distance = 34 mi).
Silt loam	This material would be used to construct the compacted clay layer within the caps.	1 mi	If necessary permits and approvals can be obtained, the majority of this material is expected to be unprocessed silt loam derived from Spreading Area B. Similar material might be available from Spreading Area A (haul distance = 1.5 mi), Ryegrass Flats (haul distance = 12 mi), and the WRRTF borrow area (haul distance = 34 mi).
Gravel	This material would be used for the coarse filter layers within the cap. Sufficient quantities of good structural gravel and fines materials are available.	2.5 mi	This material is assumed to be processed gravel derived from the Borax Gravel Pit.
Sand	This material would be used for the fine filter layers within the cap. No identified bank run borrow areas are available within the INEEL boundary.	45 mi	This material is assumed to be imported from off-Site source.
Riprap	Riprap would be used for erosion control. The majority of the mined riprap material at the INEEL has been used for other remedial actions at the INEEL.	5 mi	This material is assumed to be processed material mined from a basalt outcropping identified 5 mi from the site, directly west of the RWMC and just outside the Big Lost River System.
Coarse fractured basalt	This material would be used as bio-barrier material within the cap. The majority of the mined coarse fractured basalt material at the INEEL has been used for other remedial actions at the INEEL.	5 mi	This material is assumed to be processed material mined from a basalt outcropping identified 5 mi from the site, directly west of the RWMC and just outside the Big Lost River System.

Table 6. (continued).

Material	Issue	One-Way Haul Distance	Source
Cobbles	This material would be used as biobarrier material if coarse fractured basalt is not available or is not allowed for such use. There are no identified borrow areas within the INEEL boundary.	45 mi	This material is assumed to be processed material transported to the INEEL from Idaho Falls.

INEEL = Idaho National Engineering and Environmental Laboratory
RWMC = Radioactive Waste Management Complex
WRRTF = Water Reactor Research Test Facility

Table 7. Surface barrier design layers, thickness, and volume.

Layer	Thickness	Approximate Volume[a]	Material Description
Phase 1 Construction (105 acres with initial grading fill for grouting plus perimeter berm and side slope protection)			
Topsoil	12 in.	169,400 CCY	Unprocessed organic silt loam from Spreading Area B.
Engineered earth fill	96 in.	1,355,200 CCY	Unprocessed silt loam from Spreading Area B.
Fine filter	12 in.	169,400 CCY	Processed sand from off-Site source.
Coarse filter	12 in.	169,400 CCY	Processed gravel from the Borax Gravel Pit.
Coarse fractured basalt (biotic barrier)	30 in.	423,500 CCY	Processed basalt mined from an INEEL site.
Coarse filter	12 in.	169,400 CCY	Processed gravel from the Borax Gravel Pit.
Fine filter	12 in.	169,400 CCY	Processed sand from off-Site source.
Geomembrane	60 mil	508,200 SY	HDPE from off-Site sources.
Compacted clay	24 in.	338,800 CCY	Unprocessed silt loam from Spreading Area B.
Gravel gas collection layer	6 in.	84,700 CCY	Processed gravel from the Borax Gravel Pit.
Final grading fill	60 in.	847,000 CCY	Unprocessed silt loam from Spreading Area B.
Initial grading fill	60 in.	847,000 CCY	Unprocessed silt loam from Spreading Area B for initial 5-ft layer before grouting.
Fine filter	12 in.	15,200 CCY	Processed sand from off-Site source for surface barrier side slope protection; 41-ft long; 1-ft thick; 10,000-ft perimeter; 2.5H:1V side slopes.
Coarse filter	12 in.	15,200 CCY	Processed gravel from the Borax Gravel Pit for surface barrier side slope protection; 41-ft long; 1-ft thick; 10,000-ft perimeter; 2.5H:1V side slopes.

Table 7. (continued).

Layer	Thickness	Approximate Volume[a]	Material Description
Coarse fractured basalt	12 in.	15,200 CCY	Processed basalt mined from an INEEL site for surface barrier side slope protection; 41-ft long; 1-ft thick; 10,000-ft perimeter; 2.5H:1V side slopes.
Riprap	36 in.	45,600 CCY	Processed basalt mined from an INEEL site for surface barrier side slope protection; 41-ft long; 3-ft thick; 10,000-ft perimeter; 2.5H:1V side slopes.
Riprap	36 in.	15,600 CCY	Processed basalt mined from an INEEL site for berm side slope protection; 14-ft long; 3-ft thick; 10,000-ft perimeter; 2H:1V side slopes.
Perimeter berm	NA	244,200 CCY	Unprocessed silt loam from Spreading Area B; berm average 6-ft high, 100-ft wide, 10,000-ft perimeter; 2H:1V side slopes.
Phase 2 Construction (5 acres with no grouting, berm construction, or side slope protection)			
Topsoil	12 in.	8,100 CCY	Unprocessed organic silt loam from Spreading Area A.
Engineered earth fill	96 in.	64,500 CCY	Unprocessed silt loam from Spreading Area B.
Fine filter	12 in.	8,100 CCY	Processed sand from off-Site source.
Coarse filter	12 in.	8,100 CCY	Processed gravel from the Borax Gravel Pit.
Coarse fractured basalt (biotic barrier)	30 in.	20,200 CCY	Processed basalt mined from an INEEL site.
Coarse filter	12 in.	8,100 CCY	Processed gravel from the Borax Gravel Pit.
Fine filter	12 in.	8,100 CCY	Processed sand from off-Site source.
Geomembrane	60 mil	24,200 SY	HDPE from off-Site sources.
Compacted clay	24 in.	16,100 CCY	Unprocessed silt loam from Spreading Area B.
Gravel gas collection layer	6 in.	4,000 CCY	Processed gravel from the Borax Gravel Pit.
Grading fill	120 in.	80,700 CCY	Unprocessed silt loam from Spreading Area B.

a. This table provides estimated in-place volumes rounded to the nearest 100 CCY. To convert in-place volumes to loose volumes (truck measure), multiply in-place volumes by a factor of 1.5.

INEEL = Idaho National Engineering and Environmental Laboratory
CCY = compacted cubic yards
HDPE = high-density polyethylene
SY = square yards

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE SURFACE BARRIER ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: SURFACE BARRIER ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/24/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
FFA/CO MANAGEMENT AND OVERSIGHT											
WAG 7 Management (16-Years)											
Coordination/Oversight Tech Support (E28) - 1.0 FTE/YR		NA			32,000	HR	$ 93	$ 2,967,040			$ 2,967,040
Coordination with Agency Participants (E28) - 0.5 FTE/YR		NA			16,000	HR	$ 93	$ 1,483,520			$ 1,483,520
Environmental Engineering (E08) - 1.0 FTE/YR		NA			32,000	HR	$ 76	$ 2,421,440			$ 2,421,440
Cost and Schedule Control (F10) - 2.0 FTE/YR		NA			64,000	HR	$ 59	$ 3,768,960			$ 3,768,960
Regulatory Compliance (S11) - 1.0 FTE/YR		NA			32,000	HR	$ 79	$ 2,528,320			$ 2,528,320
Quarterly and Annual Reviews (S21) - 1.0 FTE/YR		NA			32,000	HR	$ 73	$ 2,325,760			$ 2,325,760
Audit Preparation and Coordination (S11) - 0.5 FTE/YR		NA			16,000	HR	$ 79	$ 1,264,160			$ 1,264,160
Health and Safety Coordination/Training (S08) - 2.0 FTE/YR		NA			64,000	HR	$ 62	$ 3,988,480			$ 3,988,480
Annual O&M Reports (S15) - 0.5 FTE/YR		NA			16,000	HR	$ 79	$ 1,256,640			$ 1,256,640
Attorney/Legal Fees, 0.3 FTE/YR		NA			9,600		$ 150	$ 1,440,000			$ 1,440,000
Allocation for Other Direct Costs (ODCs) - 10% of Total Labor					NA					$ 2,200,432	$ 2,200,432
TOTAL COST - FFA/CO Management and Oversight											$ 25,645,000
Construction Management											
Construction Management (@ 6% of Phase 1 & 2 RA Costs)	6.0%	NA			NA			$ 29,268,900			$ 29,268,900
General Conditions (@ 1.25% of Phase 1 & 2 RA Costs)	1.3%	NA			NA			$ 6,097,688			$ 6,097,688
Health and Safety Equipment Allocation (@ 0.25% of Phase 1 & 2 RA Costs)	0.3%	NA			NA			$ 1,219,538			$ 1,219,538
Medical Monitoring/Surveillance/Air Monitoring (@ 0.10% of Phase 1 & 2 RA Costs)	0.1%	NA			NA			$ 487,815			$ 487,815
TOTAL COST - Construction Management											$ 37,074,000
TREATABILITY STUDIES											
Treatment Treatability Studies, ISG/ISTD (@ 5% of Phase 1 Grouting, ISTD)	5.0%	NA			NA			$ 9,963,850			$ 9,963,850
TOTAL COST - Treatability Studies											$ 9,964,000
REMEDIAL DESIGN AND REMEDIAL ACTION PLANS/REPORTS											
ISTD RD/RA Workplan (@ 8% of ISTD Capital/Operation)	8.0%	NA			NA			$ 4,396,240			$ 4,396,240
PAD (A) Excavation RD/RA Workplan (@ 10% of PAD A Capital/Operations)	10.0%	NA			NA			$ 8,884,400			$ 8,884,400
GROUTING RD/RA Workplan (@ 8% of Grouting Capital/Operations)	8.0%	NA			NA			$ 11,545,920			$ 11,545,920
Surface Barrier RD/RA Workplan (@ 6% of Phase 1 & 2 Surface Barrier Operations)	6.0%	NA			NA			$ 5,850,180			$ 5,850,180
Readiness Assessment (@ 1.5% of Construction)	1.5%	NA			NA			$ 7,317,225			$ 7,317,225
Remedial Action Report		NA			5,000	HR	75.67	$ 378,350			$ 378,350
TOTAL COST - Remedial Design											$ 38,372,000

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE SURFACE BARRIER ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: SURFACE BARRIER ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/24/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
REMEDIAL ACTION - PHASE 1											
ISTD APPLICATION FOR VOC REMOVAL (5 acres)											
Capital Equipment Costs											
ISTD Control Trailer		6	EA	$ 325,000	NA				$ 1,950,000		$ 1,950,000
ISTD Off-Gas Treatment		6	EA	$ 250,000	NA				$ 1,500,000		$ 1,500,000
ISTD Off-Gas Treatment Support (Chillers)		6	EA	$ 725,000	NA				$ 4,350,000		$ 4,350,000
ISTD Capital Costs (Assume 6-ISTD Systems Are Required)		1	LS	$ 5,256,620	NA				$ 5,256,620		$ 5,256,620
Electrical Power Supply/Overhead Powerline H-Frame		3	MI	$ 375,000	NA				$ 1,125,000		$ 1,125,000
Electrical Substation/Transformers for Site Distribution		2	EA	$ 125,000	NA				$ 250,000		$ 250,000
Operation											
ISTD Operational Costs (per acre)		5	AC	$ 153,103	5	AC	$ 4,030,658	$ 20,153,290	$ 765,515		$ 20,918,805
Power Consumption/Utilities		NA			NA					$ 2,285,000	$ 2,285,000
ISTD Secondary Waste Disposal		NA			NA					$ 5,000,000	$ 5,000,000
Installation/Pre-Operational Set-up/Testing (Percentage of Total Capital Costs)	10.0%	NA			1	LS	$ 1,519,714	$ 1,519,714			$ 1,519,714
Back-up Generators (Diesel Powered)		2	EA	137,500	NA				$ 275,000		$ 275,000
Repair/Maintenance/Spare Parts (Percentage of Operating/Treatment Costs)	25.0%	NA			1	LS	$ 5,038,323	$ 5,038,323			$ 5,038,323
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 989,369	NA				$ 989,369		$ 989,369
D&D Cost for Equipment (Percentage of Capital Equipment)	10.0%	NA			NA					$ 1,443,162	$ 1,443,162
INEEL Site-Specific Training/Work Order Requirements		NA			1	LS	1,974,011	$ 1,974,011			$ 1,974,011
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 1,077,500	$ 1,077,500
Subtotal											**54,953,000**
PAD A EXCAVATION											
Capital Equipment/Disposal Bins		1	LS	$ 7,620,000	NA				$ 7,620,000		$ 7,620,000
Building; RCS Materials and Erection		94,300	SF	$ 350	NA				$ 33,005,000		$ 33,005,000
Building; Radiological, Fire Protection, CCTV, HVAC		94,300	SF	$ 250	NA				$ 23,575,000		$ 23,575,000
Weather Enclosure (Assume 10% Larger Footprint)		103,730	SF	$ 65	NA				$ 6,742,450		$ 6,742,450
Over head Crane, Monitors, Misters		1	LS	$ 350,000	NA				$ 350,000		$ 350,000
Building Operations Costs		20	MO	$ 130,208	NA				$ 2,604,160		$ 2,604,160
Overburden Soil Removal/Stockpile		12,110	CY	$ 5	NA				$ 57,765		$ 57,765
PAD A Excavation and Waste Handling (2-years)		300	CD	$ 3,217	300	CD	$ 9,115	$ 2,734,500	$ 965,100		$ 3,699,600
Equipment Repair and Maintenance (10%)		1	LS	$ 96,510					$ 96,510		$ 96,510
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 227,547	NA				$ 227,547		$ 227,547
D&D Cost for Equipment	10.0%	NA			NA					$ 7,129,245	$ 7,129,245
Characterize TRU wastes for WIPP disposal (per drum)		20	EA	$ 1,500					$ 30,000		$ 30,000
INEEL Site-Specific Training/Work Order Requirements	6.0%	NA			1	LS	$1,964,454	$ 1,964,454			$ 1,964,454
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 1,742,035	$ 1,742,035
Subtotal											**$ 88,844,000**

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE
FOR THE SURFACE BARRIER ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: SURFACE BARRIER ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/24/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
GROUTING											
EQUIPMENT											
Capital Cost - Batch Plant, Vehicles, Drill Rigs		1	LS	$ 8,326,000	NA				$ 8,326,000		$ 8,326,000
Mobilize/Erect Weather Structure Grouting Operations		2	EA	$ 750,198	NA				$ 1,500,396		$ 1,500,396
HEPA Filtration System/Lighting/Redundant Systems		2	EA	$ 2,147,448	NA				$ 4,294,896		$ 4,294,896
Back-up Generators (Diesel Powered)		2	EA	$ 375,000	NA				$ 750,000		$ 750,000
Building Foundation Construction		30,277	LF	$ 561	NA				$ 16,985,397		$ 16,985,397
Bridge Crane/Control System		3	EA	$ 670,000	NA				$ 2,010,000		$ 2,010,000
Bridge Crane/Control System/Modify and Install		NA			1	LS	$ 1,005,000	$ 1,005,000			$ 1,005,000
D&D Cost for Equipment/Enclosures	10.0%	NA			NA					$ 3,386,669	$ 3,386,669
INEEL Site-Specific Training/Work Order Requirements	6.0%				1	LS	$ 873,101	$ 873,101			$ 873,101
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 782,629	$ 782,629
Subtotal											**$ 39,914,000**
PRE-CONSTRUCTION ACTIVITIES											
Plug and Abandon (P&A) Existing GW Wells		NA			71	EA	$ 15,000	$ 1,065,000		$ 1,775,000	$ 2,840,000
Install New Nested GW Wells Outside Perimeter of Cap (Drilling Sub and Equipment)		NA			24	EA	$ 50,000	$ 1,200,000		$ 3,000,000	$ 4,200,000
Construct Rail Spur for Bulk Grout Delivery/Storage		1	LS	$ 1,200,000	NA				$ 1,200,000		$ 1,200,000
INEEL Site-Specific Training/PRD/Work Order	6.0%	NA			1	LS	$ 164,700	$ 164,700			$ 164,700
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 168,094	$ 168,094
Subtotal											**$ 8,573,000**
OPERATIONS (ISG and FDN GROUTING)											
2-Foot Thick Cover Material (Post ISG Decon)		130,000	CCY	$ 10	NA				$ 1,300,000		$ 1,300,000
Grout Trench Areas Crew/Additives		79	CD	$ 181,314	79	CD	$ 40,902	$ 3,231,258	$ 14,323,806		$ 17,555,064
Grout SVRs Crew/Additives		34	CD	$ 181,314	34	CD	$ 40,902	$ 1,390,668	$ 6,164,676		$ 7,555,344
Repair/Maintenance/Spare Parts (Percentage of Operating/Treatment Costs)	10.0%				1	LS	$ 5,460,743	$ 5,460,743			$ 5,460,743
Grout Rig Decontamination		3	EA	$ 2,125,800	NA				$ 6,377,400		$ 6,377,400
HEPA Filtration System Operation		2	YR	$ 2,000,000	NA				$ 4,000,000		$ 4,000,000
Verification Testing Geophysical Survey		4	MO	$ 40,000	2,500	HR	$ 76	$ 189,175	$ 160,000		$ 349,175
Foundation Stabilization Grouting (TRU Pits, Other Trenches)		342	CD	$ 99,763	286	CD	$ 40,902	$ 11,697,972	$ 34,118,946		$ 45,816,918
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 2,630,527	NA				$ 2,630,527		$ 2,630,527
INEEL Site-Specific Training/Work Order Requirements	6.0%	NA			1	LS	2,912,865	$ 2,912,865			$ 2,912,865
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 1,879,161	$ 1,879,161
Subtotal											**$ 95,837,000**

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE
FOR THE SURFACE BARRIER ALTERNATIVE
(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: SURFACE BARRIER ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/24/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
SURFACE BARRIER - PHASE 1											
PRE-CONSTRUCTION ACTIVITIES											
Borrow Source Site Investigation		1	LS	$ 250,000	NA				$ 250,000		$ 250,000
Spreading Area "B" 404 Permit Application (6-months)		1	LS	$ 200,000	NA				$ 200,000		$ 200,000
Surface Water Controls/Soil Erosion Sediment Control Features		1	LS	$ 250,000	NA				$ 250,000		$ 250,000
Site Preparation: Clear, Grub & Grade		125	AC	$ 3,800	NA				$ 475,000		$ 475,000
Construct 2-mile Haul Road from Borrow to Site (Stone Road)		2	MI	$ 500,000	NA				$ 1,000,000		$ 1,000,000
Install/Develop GW Wells for Compaction Water		3	EA	$ 250,000	NA				$ 750,000		$ 750,000
BUILDINGS AND EQUIPMENT											
Administrative Buildings (Lunch Room and Change Room)		10,000	SF	$ 95	NA				$ 950,000		$ 950,000
Equipment Maintenance/Storage Area		10,000	SF	$ 175	NA				$ 1,750,000		$ 1,750,000
Decontamintation Area		5,000	SF	$ 150	NA				$ 750,000		$ 750,000
Subtotal											$ 6,375,000
CONSTRUCTION											
Topsoil Layer - 1-ft Thick		169,400	CCY	$ 6	NA				$ 1,014,706		$ 1,014,706
Rip-Rap Layer - Perimeter Berm		15,600	CCY	$ 40	NA				$ 624,000		$ 624,000
Rip-Rap Layer - Sideslopes of Surface Barrier		45,600	CCY	$ 40	NA				$ 1,824,000		$ 1,824,000
Gravel Filter Layer, 1-ft Thick		169,400	CCY	$ 10	NA				$ 1,694,000		$ 1,694,000
Sand Filter Layer, 1-ft Thick		169,400	CCY	$ 25	NA				$ 4,235,000		$ 4,235,000
Gravel Filter Layer - Sideslopes of Surface Barrier, 1-ft Thick		15,200	CCY	$ 10	NA				$ 152,000		$ 152,000
Sand Filter Layer, - Sideslopes of Surface Barrier, 1-ft Thick		15,200	CCY	$ 25	NA				$ 380,000		$ 380,000
Gravel Gas Collection Layer - 0.5-ft Thick		84,700	CCY	$ 10	NA				$ 847,000		$ 847,000
Sand Filter Layer, 1-ft Thick		169,400	CCY	$ 25	NA				$ 4,235,000		$ 4,235,000
Gravel Filter Layer, 1-ft Thick		169,400	CCY	$ 10	NA				$ 1,694,000		$ 1,694,000
HDPE Geomembrane, 60-mil		508,200	SY	$ 6	NA				$ 2,795,100		$ 2,795,100
Compacted Clay Liner, 2-ft Thick		338,800	CCY	$ 12	NA				$ 4,068,988		$ 4,068,988
Biotic Barrier Layer - 2.5-ft		423,500	CCY	$ 50	NA				$ 21,175,000		$ 21,175,000
Coarse Fractured Basalt Layer - Sideslope of Surface Barrier, 1-ft		15,200	CCY	$ 50	NA				$ 760,000		$ 760,000
Engineered Earth Fill - 8-ft Thick		1,355,200	CCY	$ 5	NA				$ 6,464,304		$ 6,464,304
Grading Fill, 10-ft Thick Average (Less post ISG decon fill)		1,564,000	CCY	$ 5	NA				$ 7,460,280		$ 7,460,280
Perimeter Berm		244,200	CCY	$ 5	NA				$ 1,164,834		$ 1,164,834
					NA						
Install (37) New Lysimeters and Cap Penetrations		37	EA	$ 131,756	NA				$ 4,874,972		$ 4,874,972
OCVZ System Relocation/Well Extension		1	LS	$ 300,000	NA				$ 300,000		$ 300,000
Lab Geotechnical Testing/Compaction		40	MO	$ 50,000	NA				$ 2,000,000		$ 2,000,000
Filed Geotechnical Testing/Compaction		40	MO	$ 90,000	NA				$ 3,600,000		$ 3,600,000
Surveying/Grade Control		40	MO	$ 65,000	NA				$ 2,600,000		$ 2,600,000
Third-Party Independent CQA Testing/Certification		40	MO	$ 75,000	NA				$ 3,000,000		$ 3,000,000
Hydroseeding/Mulching (Re-seeding Included)		125	AC	$ 2,750	NA				$ 343,750		$ 343,750
					NA						
Seasonal Shutdown/Re-Mobilization		3	EA	$ 500,000	NA				$ 1,500,000		$ 1,500,000
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 1,673,639	NA				$ 1,673,639		$ 1,673,639
INEEL Site-Specific Training/Work Order Requirements	6.0%	NA			1	LS	$ 2,084,534	$ 2,084,533.74			$ 2,084,534
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 1,778,802	$ 1,778,802
Pre-Final Inspection Report, Phase i		1	LS		1	LS	$ 250,000	$ 250,000.00			$ 250,000
Subtotal											$ 84,594,000
Subtotal Subcontractor Directs - Phase 1 Remedial Action											$ 379,090,000
Subcontractor Overhead	15.0%										$ 56,863,500
Subcontractor Profit	10.0%										$ 43,595,350
TOTAL COST - Phase 1 Remedial Action			Prepared by CH2MHILL 12/20/2002								$ 479,549,000

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE SURFACE BARRIER ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: SURFACE BARRIER ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/24/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
SURFACE BARRIER - PHASE 2											
SITE PREPARATION											
Site Preparation: Clear, Grub & Grade		5	AC	$ 5,400	NA				$ 27,000		$ 27,000
Subtotal											$ 27,000
CONSTRUCTION											
Topsoil, 1-ft		8,100	CCY	$ 6	NA				$ 48,519		$ 48,519
Sand Filter Layer, 1-ft Thick		8,100	CCY	$ 25	NA				$ 202,500		$ 202,500
Gravel Filter Layer, 1-ft Thick		8,100	CCY	$ 10	NA				$ 81,000		$ 81,000
Biotic Barrier Layer - 2.5-ft Thick		20,200	CCY	$ 50	NA				$ 1,010,000		$ 1,010,000
Gravel Gas Collection, 0.5-ft Thick		4,000	CCY	$ 10	NA				$ 40,000		$ 40,000
Compacted Clay Liner		16,100	CCY	$ 12	NA				$ 193,361		$ 193,361
Gravel Filter Layer, 1-ft Thick		8,100	CCY	$ 10	NA				$ 81,000		$ 81,000
Sand Filter Layer, 1-ft Thick		8,100	CCY	$ 25	NA				$ 202,500		$ 202,500
HDPE Geomembrane		24,200	SY	$ 6	NA				$ 133,100		$ 133,100
Engineered Earth Fill, 8-ft Thick		64,500	CCY	$ 5	NA				$ 307,665		$ 307,665
Earth Grading Fill, 10-ft Thick		80,700	CCY	$ 5	NA				$ 384,939		$ 384,939
Hydroseeding/Mulching (Re-seeding Included)		5	AC	$ 2,750	NA				$ 13,750		$ 13,750
Lab Geotechnical Testing/Compaction		10	MO	$ 50,000	NA				$ 500,000		$ 500,000
Filed Geotechnical Testing/Compaction		10	MO	$ 90,000	NA				$ 900,000		$ 900,000
Surveying/Grade Control		10	MO	$ 65,000	NA				$ 650,000		$ 650,000
Third-Party Independent CQA Testing/Certification		10	MO	$ 75,000	NA				$ 750,000		$ 750,000
					NA						
Seasonal Shutdown/Re-Mobilization		1	EA	$ 500,000	NA				$ 500,000		$ 500,000
Mobilization and Demobilization	2.0%	1	LS	$ 110,507	NA				$ 110,507		$ 110,507
INEEL Site-Specific Training/Work Order Requirements		NA			1	LS	$ 147,260	$ 147,260			$ 147,260
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 125,662	$ 125,662
Pre-Final Inspection Report, Phase 2					1	LS	$ 125,000	$ 125,000			$ 125,000
Subtotal											6,507,000
Subtotal Subcontractor Directs - Phase 2 Remedial Action											$ 6,534,000
Subcontractor Overhead	15.0%										$ 980,100
Subcontractor Profit	10.0%										$ 751,410
Subtotal Subcontractor Directs and Indirects											$ 8,266,000
TOTAL COST - Phase 2 Remedial Action											$ 8,266,000.0
TOTAL COST - Phase 1 & 2 Remedial Action Contracts											$ 487,815,000
TOTAL CAPITAL COSTS											$ 598,870,000

Attachment D-3

Operable Unit 7-13/14 Feasibility Study Cost Estimate for the In Situ Grout Alternative

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost estimate are likely to occur as a result of new information and data collected during the engineering design, safety reviews, and remedial alternative. Major changes may be documented in the form of a memorandum in the administrative record file, an explanation of significant differences, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within –30 to +50 percent of the actual project cost.

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE IN SITU GROUTING ALTERNATIVE

Project Title:	WAG 7 OU 13/14 Feasibility Study
Estimator:	Brian K. Corb
Date:	December 2002
Estimate Type:	Planning
Reviewed/Appr:	Lee Lindbig/Bruce L. Stevens

I. SCOPE OF WORK:

A. Remedial Design and Remedial Action

The ISG alternative provides for the encapsulation of the buried waste in a stable monolith designed to reduce contaminant migration from the site to acceptable levels. The grouted waste materials will be further isolated from potential future human or ecological receptors through constructing a low-permeability biotic barrier cover system. Preconstruction activities will include field-scale testing of the grouting method, grout formulations with surrogate and actual waste, investigating borrow sources for the cover system, preparing of final design, completing a readiness assessment, and mobilization.

Certain areas of the site may require pretreatment before grouting. It is estimated that those areas with high concentrations of organic oils comprise a total area less than 1 acre. For these areas, ISTD will be applied to pretreat the oils. The presence of high concentrations of nitrate salts in Pad A precludes effective ISG. Pad A waste will be retrieved and stabilized in an ex situ treatment process.

Initial site activities will include setting up a grout batch plant and material delivery system and leveling some areas of the site. A modular building and crane system will be erected over areas to receive ISG. An injection lance will be driven into waste and various grout formulations will be jetted into waste as the lance is advanced. The injection lance will be retracted and the process repeated at a close spacing over the waste areas within the SDA. As ISG is completed, a modified RCRA Subtitle C cover system will be constructed over the surface of the SDA. The various layers of the cover system will include earth fill, gas collection, infiltration barrier, biotic barrier, filter, and topsoil layers. Erosion control will include constructing of a flood control berm around the perimeter of the cover system, placement of armor (riprap and other materials) on cover system and berm side slopes, and establishing vegetation.

B. Long-Term Monitoring and Maintenance

Once the RA has been completed, long-term monitoring and maintenance will continue for the 100-year window with CERCLA reviews conducted every 5 years. The long-term environmental monitoring will be conducted for groundwater, vadose zone water, surface water, and air. In addition, the cover system itself will be monitored annually during the first 5 years following completion of construction (beginning after the vegetation establishment period). After the completion of annual monitoring, the monitoring frequency will be reduced to every 5 years concurrent with the 5-year reviews required under CERCLA. The cover system will be monitored for vegetation density, erosion damage, and differential settlement. Areas of erosion damage will be repaired with additional topsoil or earthen fill and reseeded, and areas without established vegetation will be reseeded.

II. BASIS OF ESTIMATE:

The basis of the estimate was developed from the following sources to provide a defensible and comparative cost of the remedial alternatives. The applicable sources available for the ISG alternative include:

A. EPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During Feasibility Study," July 2000

B. INEEL, "Cost Estimating Guide," DOE/ID-10473, September 2000

C. "Environmental Assessment and Plan for New Silt/Clay Source Development and Use at the Idaho National Engineering and Environmental Laboratory," DOE/EA-1083, May 1997

D. *Caterpillar Equipment Performance Handbook*, 31st edition

E. The INEEL Site Stabilization Agreement, Union Labor Agreement, URL: http://home.inel.gov/labor/ineelcba.html.

F. Facilities Unit Costs—Military Construction, PAX Newsletter No. 3.2.2—10, March 2000

G. ICDF Construction Cost Estimate, Cap Construction Cost (CH2MHILL) December 2000.

H. Subject Matter Experts—M. Jackson, BBWI and T. Borschel, BBWI, "Availability of Borrow Source Material at the INEEL"

I. BBWI, "INEEL Site Craft and Professional Services Labor Rates," February 2002

J. OMB, 2002, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," Appendix C, "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses," OMB Circular A-94, February 2002.

K. R. S. Means, 2002, *Heavy Construction and Industrial Building Unit Costs Data* 16th edition, Kingston, Massachusetts.

L. INEEL "Analytical Laboratory Unit Costs."

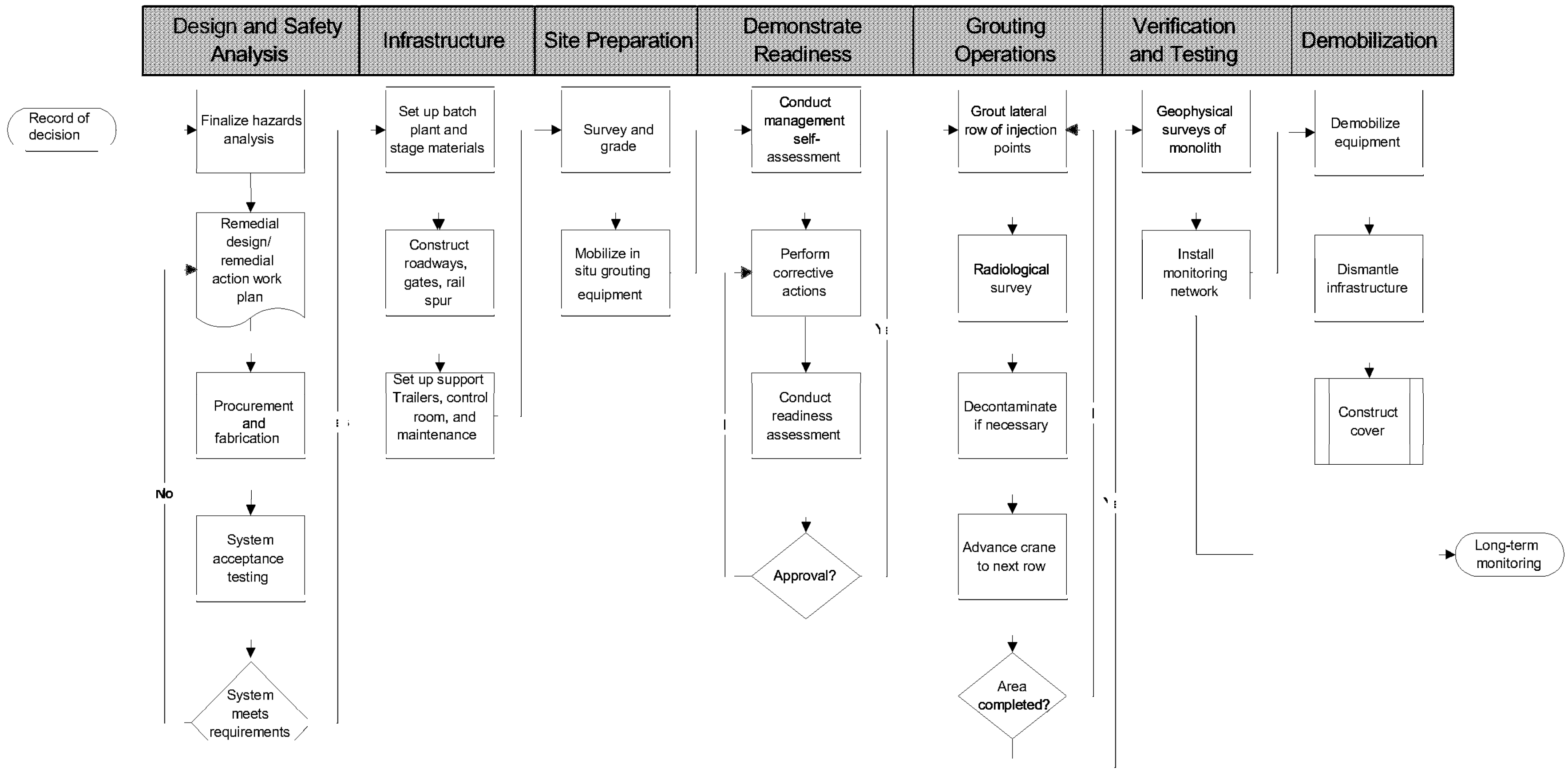
III. ASSUMPTIONS:

The primary work associated with the ISG alternative includes jet injection of various grout formulations into waste areas within the SDA. The following schematic presents a conceptual process flow describing the implementation of the ISG alternative. Specific elements of the work and important assumptions are provided below:

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE IN SITU GROUTING ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study



D-45

A. Management and Oversight

A.1 Project Management for the BBWI oversight of this alternative has been estimated based on an average classification of job categories using the BBWI rates. The number of FTEs are based on 2,000 MH per person per year.

A.2 The RD/RA schedule assumes that the budgetary funding will not be constrained.

A.3 The RD/RA schedule assumes that no unexpected delays resulting from changes to the USQ/SAR process will occur.

A.4 The estimate assumes that the INEEL site resources (i.e., CFA, medical facilities, geotechnical lab, fire department, security, and utilities at the SDA) will be available for the duration of the project.

B. Design and Preconstruction

B.1 Preconstruction activities—Borrow source investigations, cultural resource clearance, developing an onsite source of basalt rock, field-scale testing of jet grouting into waste, testing of grout formulation, final design, readiness assessment completion, and mobilization.

B.2 Design activities will include integrating the drill mast and hydraulic head of the grouting equipment onto a mobile gantry crane and designing and specifying lights, camera systems, and radiation monitors.

B.3 Grout formulations will be tested with surrogate and actual waste on bench scale to optimize formulations.

C. Site Preparation and Support Activities and Facilities

C.1 A grout batch plant will be set up near the SDA capable of producing a maximum of 500 yd^3 of grout per day.

C.2 Materials to formulate the grout will be shipped in from vendors by rail car. Access and transfer roads will be constructed to deliver materials to the site.

C.3 Administrative and equipment buildings or trailers will be installed in the SDA to support operational controls, radiation controls, and personnel facilities.

C.4 Minimal site grading and filling will ensure level terrain to operate the crane grouting system.

C.5 Thorough geophysical surveys of the SDA will be conducted to verify dimensions and determine pretreatment conditions of waste zones.

C.6 ISTD will be applied to areas of the SDA to pretreat waste with high concentrations of oils. It is assumed that these areas will comprise approximately 1 acre of the SDA.

C.7 Pad A waste will be retrieved and stabilized in an ex situ treatment process.

C.8 During development of this cost estimate, modular containment buildings were evaluated including Butler and Sprung structures. The cost provided for the ISG alternative considers a Sprung-type containment structure for the treatment grouting operation; no containment structure is assumed to be required for foundation stabilization grouting operations. Costs for these facilities include fire protection, HVAC, lighting, communication lines, and power distribution.

D. General Grouting Assumptions

D.1 Grouting equipment, enclosures, and Pad A excavation and placement equipment will be dismantled and disposed of under the cover system. Twenty-five percent of the operational and no additional cost for D&D&D is included in the estimate.

D.2 Grouting operations will be conducted in a large modular building that provides defense in depth for remediation workers. The building is maintained under negative pressure and ventilated through a HEPA filtration system. Because of the structure over grouting operations, no thrust blocks will be necessary. The building is approximately 80-ft wide and has several long modular sections connected end-to-end to provide a long strip. The modular sections will be disassembled and reassembled to facilitate continuous advancement of the grouting operation.

D.3 Grouting operations will commence with positioning the injection crane system over the first grout area. It is envisioned that the injection lance will be moved in short increments laterally across the span of the crane and that the crane will be incrementally advanced forward across long strips of ground. The actual positioning, spacing, and sequencing of drilling will be optimized during the remedial design. It is assumed that the grout will be injected on a triangular pitch grid at approximately 20-in. centers to ensure every 55-gal drum is grouted on the inside.

D.4 Grout will be mixed at the batch plant adjacent to the SDA and delivered by truck to the ISG operational area. The grout truck will be received at the pump house and grout will be fed into high-pressure positive displacement pumps. The grout will be delivered to the injection lance by a system of high-pressure lines.

D.5 The injection lance will be driven with rotary percussion action into the soil and waste to a depth of 20 ft or until refusal. Once the maximum depth is reached, grout will be pumped down the center of the injection lance, and out two jet nozzles at the tip. The injection lance will be rotated and slowly retracted as the grout is jetted into the formation. Grouting will be stopped at the waste/overburden interface.

D.6 The injection lance will be fully retracted and the lance assembly will be surveyed remotely for radiological contamination. High-volume air monitors mounted on the crane near the injection lance also will be used to detect any airborne contamination. If contamination is detected, the equipment will be decontaminated.

Any inadvertent grout returns will be covered periodically with clean soil. The injection lance will be moved laterally one increment and the injection process will be repeated. When all the points under the span of the crane have been grouted, the crane will be walked forward an increment and the process repeated.

D.7 Verification and Testing—Following the injection of grout, posttreatment geophysical surveys will be conducted to verify the extent of the grout monolith. High contrast in moisture content and density will be used as indicators of the vertical and horizontal extent of the monolith. Operational data including the pressures and volume of grout injected over each area will be evaluated to verify the thoroughness of each grouting campaign.

D.8 Process Areas—Based on preliminary information in the PERA, the remediation will focus on several areas within the SDA that contribute to the future potential risk. Areas will include the TRU pits, TRU trenches, activation and fission product waste in the non-TRU trench areas, SVRs, and foundation stabilization. Each area will require a slightly different approach. The actions taken at each area and the size of each area is a critical factor in the basis for the cost estimate. Area sizes and production rates are provided in Table 1.

E. Grouting Large Areas

E.1 For grouting large areas (pits, trenches), it is assumed that each hole will take 4 minutes to drill and grout before moving to the adjacent point (low of 2 minutes, high of 6 minutes). (Past experience on simulated waste pits showed 6 to 7 minutes, including time to move drill rig between holes [Loomis, Zdinak, and Bishop 1997]. The crane-positioning system is expected to significantly reduce time required to move between holes.)

E.2 Wheel-mounted gantry cranes are commercially available with 60-ft spans and up to 80-ton capacity from commercial vendors (e.g., Shuttlelift). (It is expected that the injection apparatus, including hydraulic pump will weigh less than 20 tons [the weight of the entire sonic probing rig currently used at the SDA]). Assuming 2 ft on either side are unreachable by the injection point, the grouting span is 56 ft. Using 20-in. spacing, 33 holes can be drilled in one row. Time to move the crane approximately 20 in. forward to the next row is estimated at 5 minutes, including time for radiation monitoring.

E.3 Each row of 33 holes is estimated as 4 min/hole × 33 holes + 5 min = 137 minutes.

E.4 A rectangular area similar to Pits 4, 6, or 10 will be grouted in two to three passes. It is assumed that turning the crane and setting up on a new swath will take one shift.

E.5 To estimate the time required per acre, assume three moves (three shifts) and three 56-ft-wide swaths 260-ft long (3 × 56 ft × 260 ft = 43,680 ft^2). Each swath will require 156 rows. At 137 minutes per row, and a total of 468 rows (156 × 3), each acre will require 1,069 hours plus 30 hours for moves, or about 1,100 hours.

E.6 The basic production rate for grouting the pits and trenches will be 1,100 hours per acre per rig, not accounting for any inefficiencies.

E.7 A 70% factor will be applied to account for inefficiencies caused by routine and nonroutine delays (e.g., radiation surveys, instrument calibration, breakdowns, donning and doffing PPE). It is assumed that in every 10-hour shift, only 7 hours will be spent grouting. The adjusted production rate is 1,571 hours per acre, per rig.

E.8 The grouting operation will be controlled from an operations control room (a trailer or building as described in Assumption J). It is assumed that a crew of 10 will be required to operate one injection system (one manager, one supervisor, one crane operator, one pump operator, two radiological control technician [RCTs], one HSO, one quality assurance [QA] specialist, and two maintenance).

F. Grouting Soil Vault Rows

F.1 Treating the soil vaults with grout to immobilize radioactive fission products and other contaminants is estimated to take less than 100 days (10 hours) of work for the actual grouting operations and will require approximately 2,000 yd^3 of cementitious grout.

F.2 The soil vaults are small holes augured into the SDA soil where high activity debris waste was disposed of to prevent personnel exposure. The holes were augured in linear arrays called SVRs. The auger holes were either 18 or 54 in. in diameter. Each of the 20 soil vaults has a large number of individual soil vaults of varying size. By observing the soil vaults represented on an INEEL geographical information system map of the SDA (INEEL map trench_shipments-dlv-31.mxd, 12/31/01), it is estimated that there are 344 individual vaults of 27 in. radius, and 298 individual vaults with 8 in. radius.

F.3 Grout injection lances will be driven down along the perimeter of each soil vault. It is assumed that two injections will be required for every 9-in. radius hole, and that four injections will be required for every 27-in. radius hole. Because all the vaults are arranged in a linear array, each less than 50 ft wide, it is assumed each row can be grouted in a single pass of the grout injection crane. Crane moves will be required between SVRs (20 in all).

F.4 The time to drill and grout each borehole and move to an adjacent borehole is estimated at 4 minutes (the same time estimated in a large pit configuration). With a total of 1984 boreholes, total time to drill grout is ($4 \times 1984 \div 60$) 132 hours.

F.5 The time to walk the crane forward to the next position is estimated to take 5 minutes for each move (the same time required to move between rows in a large pit configuration), times the number of moves required. The number of moves required is estimated by dividing the total length of the SVRs (3,600 ft) by 20-in. increments (3,600 ft $\times$ 12 in. $\div$ 20 in. = 2,160). Therefore, the time required to walk the crane forward from vault to vault is 180 hours. The total length of the soil vaults from INEEL geographical information system data is 7,141 ft, excluding Row 21. However, this length includes large areas that have no vaults (presumably the soil was too shallow). Therefore, the length of the vault areas to be grouted, as estimated from manual measurements taken from the map of the SDA, is 3,600 ft.

F.6 The time to move the apparatus between SVRs is estimated as two days because the rows are spread out across the SDA. As there are 20 SVRs, it is estimated that 40 days will be required to move the apparatus between SVRs. (The soil vaults are grouped together in areas with deep soils, therefore it is likely that fewer moves will actually be required.)

F.7 The basic production rate for grouting the soil vault rows is 712 hours for all soil vaults using one rig, not accounting for any inefficiencies.

F.8 To account for inefficiencies caused by routine and nonroutine delays (e.g., radiation surveys, instrument calibration, breakdowns, donning and doffing PPE) a 70% factor will be applied. It is assumed that of every 10-hour shift, only 7 hours will be spent grouting. The adjusted production rate is 102 days for all soil vaults using one rig.

G. Low Level Waste Trenches

G.1 The production rate for grouting the activation and fission product waste areas within the low-level trenches is assumed to be the same production rate as for the TRU pit and trench areas. Assuming 1.5 acres will require grouting, and applying the 70% efficiency factor, grouting the activation and fission product waste areas will take 238 days.

H. Grouting for Cover System Foundation Stabilization

H.1 The grouting technique used for foundation stabilization will be nonreplacement in situ jet grouting as developed for the INEEL. This technique employs a modified drill rig to inject grout under high pressures into the waste seam. The grout will fill all readily accessible void space and will cure into a solid monolith. Because the waste and grout monolith will be supported on five sides and void space will be filled, subsidence will be eliminated regardless of the final compressive strength of the waste, soil, and concrete product. This will permit using widely available, inexpensive grouts (e.g., Portland cement).

H.2 Unlike grouting for waste treatment, it will not be required that the grout be intimately mixed with the waste or soil, nor will it be required that the grout fill soil pore space or other small void spaces inside individual waste drums. Because actual data regarding void space in the SDA is not available at this time, it is assumed for purposes of the PERA evaluation that voids threatening the integrity of the cap are fairly large and will be intersected if the grout is injected on a 4-ft center-to-center spacing across the areas requiring stabilization. Although this spacing does not ensure that every container is intersected, it is assumed to be adequate to support the cap. During the remedial design, a records review and geophysical program will be performed in an attempt to characterize the size and extent of the large void areas.

H.3 The production rate for foundation stabilization grouting will be substantially greater than that required for waste treatment because of the increased spacing and fewer number of grout holes required. The time required to grout for stabilization is estimated to be a factor of four less than the basic production rate.

H.4 The basic production rate for grouting the remaining pit and trench areas (9.8 acres) is estimated as (1/4) (1,100 hours/acre) (9.8 acres), 2695 hours. Applying 70% efficiency yields 3,850 hours, or 385 10-hour days.

I. Grout Batch Plant Production Rate

I.1 The grout will be produced at a batch plant located adjacent to the SDA. The batch plant will be sized to feed three injection systems simultaneously. Each acre of waste will require 13,552 yd^3 of grout (60% of the volume assuming 14-ft depth). Each rig will grout an acre in 157 days. Therefore, each rig will consume an average 86 yd^3 of grout per day. (Note: Using an inefficiency factor extends the duration of the grouting operation, but the volume of grout remains constant.)

I.2 The batch plant will be operated the same number of days as the injection system. The batch plant will require an additional crew of 10 (one manager, one supervisor, three operators, two QA inspectors, and three drivers).

J. Grout Volume

J.1 Large areas (pits and trenches)—Each acre of waste is assumed to be ($43,560 \text{ ft}^2 \times 14 \text{ ft} \div 27 \text{ ft}^3/\text{yd}^3$) 22,587 yd^3 of volume to be treated. It is assumed from past testing and a cursory review of waste stream disposal information (Armstrong, Arrenholz, and Weidner 2002) that grout take can be estimated as 60% of treatment area volume. Therefore, each acre will require 13,552 yd^3 of grout. Grout volume for large areas are estimated in Table 2.

J.2 Soil vaults—Total grout required is estimated as 60% of the volume of the soil vaults (the same assumption of 60% void space as used in the large pits). The soil vaults would be 14-ft deep (not counting overburden, which will not be grouted), the volume of the large soil vaults are 224 ft^3 each ($\text{pi} \times r^2 \times h = \text{pi} \times (27 \text{ in.} \div 12 \text{ in./ft}^2) \times 14 \text{ ft} = 224 \text{ ft}^3$). Similarly, the volume of the small vaults is 25 ft^3 ($\text{pi} \times (9 \text{ in.} \div 12 \text{ in./ft})^2 \times 14 \text{ ft} = 25 \text{ ft}^3$). The total volume to be treated is estimated as approximately 300 small vaults $\times$ 25 ft^3 each, (7,500 ft^3) plus approximately 350 large vaults $\times$ 224 ft^3 each (78,400 ft^3), 85,900 ft^3, or ($8,500 \text{ ft}^3 \times .03704 \text{ yd}^3/\text{ft}^3$) 3,182 yd^3; 60% will equal 1,909 yd^3 of grout.

K. Grout Costs

K.1 Based on previous experience with ISG at the INEEL, the cost for grouts have ranged from \$1/gal (\$202/yd^3) for Portland Type H to \$5/gal (1,010/yd^3) for proprietary grouts (e.g., TECT or Waxfix) based on vendor data in the *Innovative Subsurface Stabilization Project* (Loomis, Zdinak, and Bishop 1997). However, the prices experienced during this and other field tests were escalated because of the small quantities of grout involved. These prices also reflected total delivered costs. Bringing ingredients in bulk and mixing large quantities onsite will result in significantly lower production costs. One vendor has estimated that production costs will be half of those cited in the *Innovative Subsurface Stabilization Project* (Loomis, Zdinak, and Bishop 1997). Recent vendor estimates for specialized grout, tested for application at the SDA, are \$505/yd^3 material costs.

L. Organic Area Treatment with In Situ Thermal Desorbtion

L.1 The ISTD will be used to treat the high organic waste streams within the SDA. ISTD will employ an array of heated stainless steel pipe assemblies inserted into the ground on an 8 × 8-ft spacing to a depth of approximately 3 ft below the buried waste.

L.2 It is assumed that each pipe assembly will include a sealed pipe that contains an electrical-resistance heating element, a vented pipe used to extract gases, and thermocouples. Extraction pipes will be connected to a pipe manifold that conveys the gases to an off-gas treatment system. The average pipe assembly will be inserted to a depth of 24 ft. Pipe assemblies will be inserted into the ground using either nonstandard vibratory or hydraulic techniques.

L.3 It is assumed that heat can be transferred from the heating elements to the pipes and then to the waste at a nominal rate of 350 W per linear foot of heated pipe.

L.4 Six ISTD systems will be used. With the 8 × 8 ft spacing of the pipe assemblies, heating will occur during an approximate 90-day period. The six systems are projected to treat approximately 0.5 acre/year, requiring 1 year to complete the projected 1 acre.

L.5 The ISTD systems will require about 330 kW.

L.6 When a subsystem reaches its heating objectives, the pipe manifold that collects off-gases will be isolated from the rest of the off-gas manifold by closing valves. The 12 or 20 extraction pipes in the subsystem will be crimped closed, the manifold section will be disconnected and transported to the front of the advancing ISTD system, and reconnected after purging at that location.

M. Pad A waste retrieval and management.

M.1 Retrieved non-TRU waste and soil will be treated onsite and fixated through an ex situ grouting technology (pugmill). Large metal waste will be sized, placed in containers, and the containers filled with a grout matrix. The grouted materials will be placed in a central portion of the SDA and covered with the surface barrier.

M.2 It is assumed that 20 drums of TRU waste and soil will be generated during the retrieval actions, which will require off-Site disposal at WIPP.

M.3 The Pad A retrieval operations will require a primary and secondary containment structure, approximately 230 × 410 ft in plan dimensions and designed in accordance with the IBC. Frost depth for building foundations is 5 ft (DOE-ID 2001). The ground snow load of at least 35 lb/ft^2 shall be used in (ASCE) 7 calculations and a minimum roof snow load of 30 lb/ft^2 shall be used for all buildings (DOE-ID 2001). Retrieval buildings and other structures shall not be designed for tornado loads (DOE-ID 2001). All structures shall be designed for PC 2 standards for wind, seismic, and flood design requirements. The PC 2 seismic return period is 1,000 years (STD-1020). The fastest wind speed for INEEL structures is 70 mph, and the 3-second gust wind speed is 90 mph (DOE-ID 2001). The design mean hazard annual probability for floods is 5E-04, or a 2,000-year return period (STD-1020). Fire protection systems shall meet or exceed the minimum requirements established by the NFPA and DOE O 420.1.

M.4 The primary and secondary containment structure is a double-walled structure that would be equipped with radiation alarm systems such as constant air monitors set to alarm when airborne contamination reached unacceptable levels. Criticality alarms would be installed in the primary containment structure. These alarm systems would require periodic testing and calibration.

M.5 It is assumed that the containment building will be dismantled and buried beneath the surface barrier. A cost allowance of 25% of the capital expenditures of the building costs is assumed to be representative of the estimated level of effort to dispose of the buildings and equipment.

M.6 The structure would include a gantry crane that would be used to apply water, foams, and foggers to keep dust and contamination at a minimum within the retrieval operation. The crane would provide support for lifters, detectors, and other equipment.

M.7 Negative pressure would be applied to the digface at all times and directed to HEPA filters to control the contamination and keep it from entering the secondary containment structure. The air exhausted from the retrieval zone would be fully saturated with water vapor because of the application of mists to control airborne contamination. Some of the water vapor would condense in the ductwork leading to the air treatment system. This condensate would be recycled through the retrieval-face misting system, as would other condensates. The air treatment system consists of chillers, demisters, heaters, and banks of HEPA filters in two parallel systems to provide redundancy in the event one systems failed. The chillers would cool the air, which would decrease the dew point of the air and cause mists to form. The air would then pass through a demister, which would remove moisture from the air. The air would pass through heating elements to raise the temperature to about 10°C above the dewpoint. The air would then pass through the HEPA filters.

N. Borrow Areas

N.1 It is assumed that Spreading Area B will be available and will not be flooded. No additional costs have been provided to dewater Spreading Area B.

N.2 It is assumed that there an adequate quantity and quality of borrow source material is available from Spreading Area B, the Borax Pit, and the Basalt Source (for riprap and coarse fractured basalt). Furthermore, no royalty fee and earthen material costs are provided for in the estimate.

N.3 It is assumed that an adequate water source will be available to support the earthmoving and soil moisture conditioning for placement and compaction based on the equipment productivities developed for this estimate.

O. Cover System Construction

O.1 Placement of earth fill—An average 10-ft-thick layer of earthen fill will be placed over the surface of the SDA to grade the surface and to prepare for placement of the cover system.

O.2 Placement of gravel gas collection layer—A 6-in.-thick layer of processed gravel will be placed over the earthen fill to vent any gases that might build up beneath the cover system.

O.3 Earthen fill and the gravel gas collection layers of the cover system will be placed during grouting.

O.4 Placement of asphalt, lateral drainage, and filter layers—A 4-in. asphalt base course and a 6-in. low-permeability asphalt layer will be placed over the gas collection layer to function as infiltration barriers. A 6-in. lateral drainage layer consisting of processed sand will be placed over the asphalt to remove infiltration from the surface of the barrier layer. A 1-ft-thick filter section consisting of sand and gravel will be placed over the lateral drainage layer.

O.5 Placement of remaining cover system layers—Remaining cover system layers will consist of a 20-in. compacted topsoil layer and a 20-in. layer of topsoil with gravel.

O.6 Placement of perimeter berm and erosion controls—A 6-ft-high berm will be constructed around the perimeter of the cover system to control flooding; filter layers, coarse fractured basalt, and riprap will be placed on the side slopes to minimize erosion.

O.7 Vegetation establishment—The topsoil layer will be seeded with a specialized seed mix to provide a vegetative cover. The cover will be monitored and reseeded as necessary to maintain the vegetative layer.

P. Capital Costs, Unit Rates, and Other Pricing Assumptions

P.1 The unit prices were developed from a crew build-up to process, load, haul, place, and compact. The volume of material represented in the cost tables identifies CCY. The appropriate factors convert the estimated unit material weights (bank, loose, and fill) and are factored into the equipment productivity.

P.2 Crew labor rates were developed based on hourly rates stipulated in the INEEL Site Stabilization Agreement. Labor and equipment spreads were developed based on the assumed achievable daily productivity to support the project schedule. Other factors that influenced the selection of labor and equipment quantities included safety considerations, level of PPE of the work to be performed, haul routes, and availability of resources on the INEEL. Each daily crew cost also includes field oversight personnel such as the HSO, superintendents, foremen, CIHs, maintenance personnel, and allocation of supplies (e.g., fuel, oil, grease, and spare parts).

P.3 In general, all capital equipment and pricing were selected from commercially available sources or similar projects. A scale factor will be applied to estimate cost of equipment and operational requirements. Equipment installation cost is considered to be a significant variable in estimating individual components of a given system. For the basis of cost, the installation cost of the capital equipment was based on a percentage of the capital costs ranging from 110 to 160% of the estimated capital expenditure based on the unknowns and level-of-complexity.

P.4 Subcontractors bond and insurance rate of 2% of the total subcontractor dollars includes overhead, and profit has been included based on each alternative.

P.5 The estimate includes an allocation for the INEEL specific work order program, requirements document (PRD) requirements, and safety meetings. Because this estimate includes primarily unit prices, the labor cost is estimated to be 40% of the unit prices and, based on historical data, cost of the INEEL-specific process is approximately 6% of total labor dollars.

Q. Schedule

Q.1 The estimate assumes that construction operations can be performed for 10 months year without weather impacts. Grouting construction will be performed during this time working one 10-hour shift per day. Cover system construction is scheduled for two 10-hour shifts, with a back shift that performs maintenance. Employees will work 5 days per week.

Q.2 The estimate assumes that field crews will demobilize the equipment during the 2-month winter shutdown period to refurbish and replace equipment. The estimate includes an allocation to cover these costs in addition to the 2% estimated.

R. Health and Safety

R.1 For the ISG operation, a preliminary hazards analysis indicates that the ISG operation will be classified as other than a nuclear low hazard radiological operation. A safety analysis report will not be required. The remedial design, however, will include a final hazards analysis, a criticality evaluation, and a comprehensive health and safety plan.

R.2 It is assumed that once the earthen fill material is placed over the SDA, all earthmoving operations for the cover system can be performed in Level D.

S. Long-term Operating and Maintenance and Monitoring

S.1 The monitoring program will be the same as for the No Action alternative (see Section D-1).

S.2 The capital cost for the project includes replacing the groundwater wells and lysimeters removed as part of site preparation activities. The estimate assumes that nested wells and lysimeters will be installed at varying depths of 20, 90, 200, and 600 ft along the interbed surfaces.

S.3 The lysimeter analytical cost assumes that liquid samples will be recovered in 10% of the wells. Therefore, analytical costs are included only for the assumed number of recoverable samples.

S.4 It is assumed that after topsoil has been placed as the final layer on the cover system, it will be seeded with native grasses to provide vegetative cover for reducing erosion. However, because of the arid climate of the INEEL, an extended period will be required to establish a permanent vegetative cover. Erosion of the uppermost layers of the cover system during snowmelt will occur during years immediately following construction, and repairs and reseeding will be required.

S.5 It is assumed that ongoing maintenance of the cover system will be required in perpetuity after construction is completed. It is assumed that frequent maintenance will be required during the years immediately following construction to repair damage from erosion and to establish a permanent vegetative cover. In addition, the added weight of the cover system is expected to result in increased settlement during the initial years following construction. Some areas of the cover system will require ongoing maintenance to repair damage resulting from settlement. It is expected that annual maintenance and repairs will be required during the first 5 years following construction. Ongoing maintenance and repairs will continue every 5 years concurrent with the 5-year review process.

T. Design Costs

The following discussion provides the basis for the assumed percentage for design, construction, and contingency. EPA provides guidance for estimating remedial design costs in the EPA Guidance. Exhibit 5-8 of the EPA Guidance provides examples of remedial design costs as a percentage of total capital costs. The percentages range from 20% for projects with capital costs less than $100,000 to 6% for projects with capital costs greater than $10 million. The EPA Guidance does not provide an example of design costs that vary according to the complexity of technologies.

For the WAG 7 PERA, the alternatives include technologies that have been demonstrated on other sites and have well developed engineering design criteria (such as capping), and technologies that have not been demonstrated on a large scale and require development of engineering design criteria (e.g., ISV). For the WAG 7 PERA alternatives, remedial design costs are expected to vary significantly according to the degree of complexity. The estimated costs for remedial design need to reflect the varying degrees of complexity. Based on the complexity of the technology application, a percentage of the capital and operating cost specific to the technology was assumed.

The modified RCRA Subtitle C cap has been demonstrated on other sites and design standards have been developed for the various types of materials and construction methods. Some borrow source investigations will be needed to verify material properties and quantities, but methods for conducting these investigations are not expected to require specialized equipment or personnel. Because capping is a demonstrated technology with established design standards, the cost for remedial design is assumed to be 6% of capital costs.

ISG includes subsurface jet injection of specialized types of grout into waste disposal areas of the SDA to stabilize and treat waste materials. ISG will need to be done inside a modular building to contain possible releases of contaminants. Some waste disposal areas will require pretreatment before grouting. Considerable effort will be needed to design appropriate grout types for the waste disposal areas, design the modular building and grouting equipment, determine areas of the site that will need pretreatment, and field test the various design elements. Because of the additional design effort required for ISG, the cost for remedial design is assumed to be 8% of capital costs.

Foundation stabilization grouting includes using modified grouting equipment to jet grout areas of the SDA to fill voids within the waste and provide a stable foundation for placing and maintaining cover systems. Foundation stabilization grouting is similar to ISG, except specialized grout and grouting equipment (including a modular building) will not be needed and grout holes will be spaced further apart. Cement-based grout and modified grouting equipment will be used for this technology. Some field demonstrations will be conducted to verify the ability of the grouting equipment to penetrate the waste disposal areas and to estimate the approximate quantity of grout that will be needed. Because the design effort will be considerably less for foundation stabilization grouting than for ISG, the cost for remedial design is assumed to be 7% of capital costs.

Retrieval and disposal includes excavating waste from Pad A; characterization and ex situ treatment of waste materials; packaging, shipment, and off-Site disposal of treated TRU waste; and disposal of treated non-TRU waste in an onsite, engineered waste disposal facility. A large containment structure will be needed to prevent releases of contaminants during waste retrieval activities. A very high level of effort will be necessary to design methods to safely retrieve waste from disposal areas, characterize waste for treatment and disposal, design treatment methods and facilities, and plan for safe handling and transport of waste to an off-Site disposal facility. Because of the very intense design effort required for this technology, the cost for remedial design is assumed to be 10% of capital costs.

The various technologies and percentages of capital costs estimated for remedial design are summarized in Table 3. These percentages are applied to individual technologies in the cost estimate to establish estimated design costs for the various alternatives.

U. Construction Management Costs

Cost considerations for BBWI oversight, regulatory agency interaction, and project management were estimated on an assumed level of effort required to implement the selected alternative. Additionally, costs for the remedial design, safety equipment and PPE, construction management, general conditions, and insurance and bonds were included in the estimate to capture a relative basis for cost comparison and to identify other costs associated with implementing a given remedial alternative.

The percentage is based on the total capital construction cost to implement the alternative. The percentage basis assumed for each category identified was selected considering the complexity of the alternative and risk and uncertainty of the approach. The cost conjunction with the percentage basis identified under the general conditions category includes administration buildings, parking area, utilities, and support infrastructure to facilitate the remedial alternative.

V. Contingency Costs

The EPA provides guidance for estimating contingency costs in the EPA (EPA 2000), which distinguishes between scope contingency and bid contingency costs. Scope contingency costs represent risks associated with incomplete design and include contributing factors such as limited experience with technologies, additional requirements because of regulatory or policy changes, and inaccuracies in defining quantities or characteristics. Exhibit 5-6 of the EPA Guidance provides examples of scope contingencies. Bid contingency costs are unknown costs at the time of estimate preparation that become known as remedial action construction or O&M proceeds. Bid contingencies represent reserves for quantity overruns, modifications, change orders, and claims during construction. The EPA Guidance states that bid contingencies may be added to construction and O&M costs and typically range from 10 to 20%.

Because EPA Guidance suggests that contingency costs will vary according to the alternative technologies, it is necessary to estimate contingency costs for the PERA alternatives. Technologies have been evaluated separately to determine appropriate contingency costs. Scope and bid contingencies for each technology are discussed below.

Capping technology includes placement of the modified RCRA Subtitle C cap. This cover system include using several types of materials in addition to those planned for biotic barrier technology, constructing of infiltration barriers, and using synthetic materials. One significant assumption for this technology is that available native materials will be capable of meeting infiltration barrier layer permeability requirements without using additives (e.g., bentonite). Capping technology is assumed to require a scope contingency within the range of 10 to 20% as shown in Table 2. Because of the risk associated with needing additional borrow sources for materials, using synthetic materials, and the possible need to use additives for infiltration barrier layer construction, the cost for the scope contingency is assumed to be 15%. Most risks associated with capping technology will be significantly reduced during remedial design, therefore the cost for the bid contingency is assumed to be 10%. The total contingency for capping technology is assumed to be 25% of capital costs.

In situ grouting includes jet injection of various types of grout into waste materials in the SDA to stabilize and treat waste materials. ISG technology will require consideration of pretreatment for some waste disposal areas, grout design for different types of waste, design of specialized grouting equipment and a modular containment building, and field demonstrations. ISG technology is assumed to require a scope contingency within the range of 15 to 35% as shown in Table 3. Because of the specialized design efforts required for this technology, cost for the scope contingency is assumed to be 20%. Some significant construction risks still will be associated with this technology because of unanticipated subsurface conditions, therefore the cost for the bid contingency is assumed to be 15%. The total contingency for ISG technology is assumed to be 35% of capital costs.

Foundation stabilization grouting includes jet-grouting areas of the SDA with cement-based grout to fill voids in the waste and provide a stable foundation for placing and maintaining cover systems. While foundation stabilization grouting is similar to ISG, design of specialized types of grout and a modular containment building will not be required. Scope and bid contingencies for foundation stabilization grouting are the same as those for ISG (20 and 15%, respectively) with a total contingency for foundation stabilization grouting assumed to be 35% of capital costs.

Retrieval and disposal involves excavating and removing waste from Pad A followed by treatment and disposal. An intensive design effort will be required to determine methods to characterize and treat waste, to package and ship TRU waste for off-Site disposal, to handle and dispose of non-TRU waste at an onsite disposal facility, and to design and construct onsite treatment and disposal facilities. Each of these design efforts could result in significant changes in project scope. Retrieval and disposal technology is assumed to require a scope contingency within the range for soil excavation in Table 2 (15 to 35%). Because of the high potential for scope changes associated with this technology, the cost for the scope contingency is assumed to be 25%. Considerable construction risks will be associated with this technology because of the uncertainties associated with excavating buried waste materials. Because of the considerable construction risks, the cost for the bid contingency is assumed to be 20%. The total contingency for retrieval and disposal technology is assumed to be 45% of capital costs.

The scope and bid contingency percentages associated with this alternative are identified in Table 4. These percentages are applied to individual technologies in the cost estimate to establish a representative aggregate cost contingency.

Following the cost contingency guidance provided in Table 5 for each of the technologies, a representative contingency was selected within the range provided, based on the complexity and size of the project and inherent uncertainties related to the remedial technology. However, the guidance document does not address all of the remedial technologies identified in this alternative. Specifically, the foundation stabilization grouting and ISG technology would be within a cost contingency range of 20 to 35% and are considered representative for this work and project scope.

IV. SCHEDULE:

The following activities comprise the RD/RA portion of the ISG alternative. The corresponding durations are based on the estimated crew productivity, regulatory reviews and approvals, and weather constraints inherent to the INEEL site. They are presented in Table 6.

V. PRESENT WORTH ANALYSIS:

Guidance for present value analysis is provided in Chapter 4 of the EPA Guidance, which states that the present value analysis of a remedial alternative involves four basic steps:

1. Define the period of analysis
2. Calculate the cash outflows (payments) for each project year
3. Select a discount rate to use in the present value calculation
4. Calculate the present value.

Periods of analysis for the ISG alternative include design and construction, and O&M. The design and construction period is estimated to 14 years, beginning shortly after issuance of a ROD for the site. The O&M period will begin toward the end of the vegetation establishment period and will continue for 100 years.

Cash outflows for the ISG alternative will include payments for design and construction, periodic payments for major repairs, and annual O&M costs. EPA Guidance suggests that most capital costs should be assumed to occur in the first year of remedial action, when funds are committed. While this suggestion might be a realistic assumption for short-duration remedial actions, it is not realistic for the ISG alternative because of the time required for design and construction. Cash outflows for the ISG alternative will be paid on an annual basis as costs are incurred, beginning with the grout testing and remedial design, and ending with vegetation establishment.

Annual capital cost payments vary with the level of activity, with relatively low annual payments during the borrow source and grout investigations, remedial design, readiness assessment, and vegetation establishment periods, and relatively high annual payments during heavy construction periods (grouting and material excavation, processing, stockpiling, and placement). Periodic costs for major repairs would occur every 5 years concurrent with the 5-year reviews conducted in accordance with CERCLA requirements. Periodic costs would begin 5 years after Phase 1 construction and continue through the O&M period. Annual O&M costs would begin the first year after completion of construction and continue for 100 years. In accordance with EPA Guidance requirements, 2002 constant dollars are used for all annual and periodic cash outflows.

EPA Guidance requires using a real discount rate that approximates the marginal pretax rate of return on an average investment and has been adjusted to eliminate the effect of expected inflation. The real discount rate must be used with constant or real dollars that have not been adjusted for inflation. EPA Guidance recommends using a 7% real discount rate for present value analysis in most remedial action cost estimates. However, for federal facility sites being cleaned up using Superfund authority, EPA Guidance states that it is generally appropriate to apply the real discount rates found in Appendix C of OMB Circular A-94. The suggested rates for federal facility sites are based on interest rates from Treasury notes and bonds and are appropriate because the federal government has a different cost of capital than the private sector. The most current version of Appendix C of OMB Circular A-94 (revised February 2002) proposes a real discount rate of 3.9% for programs with durations longer than 30 years. The 3.9% discount rate and constant dollars are used for the present value analysis of the ISG alternative. The present value of the ISG alternative is calculated using the equations provided in EPA Guidance.

VI. RISK AND UNCERTAINTY:

A significant uncertainty in this evaluation is the time and effort required to design and implement remediation systems for Pad A and the organics areas. Although the total areas are relatively small, they could have a significant impact on the cost of this alternative. A hazard classification is not currently available for retrieving waste from Pad A and the ISTD treatment of the organics areas. It is unclear what level of safety analysis and design will be required for these components. It is unclear whether safety significant systems will be required.

The time required to drill and grout each hole is estimated at 4 minutes. Actual times could be significantly less or greater depending on soil type and waste type encountered. An uncertainty of up to 50% could be applied to the 4-minute estimate.

Another issue is that volume and surface area estimates are inconsistent. Assuming a 14-ft depth to be treated, and using the surface area of pits, trenches, and vaults yields a higher volume to be treated than if the total volume were used. To be conservative, the ISG cost estimates were based on the surface area and assumed a constant 14-ft depth for the volume to be treated. The actual volume may be 50% less.

The production rate for operations (retrieving waste from Pad A and grouting the SDA) is dependent largely on the waste types encountered. Unexpected hazards (e.g., explosives, reactives, pressurized containers) or simply impenetrable layers of waste could cause significant delay in the schedule. It is unlikely that the feasibility study cost estimate guidelines of +50%/–30% could be met without a much more rigorous analysis.

The schedule is highly uncertain. The estimates included here are intended to be high-level examples and are not an adequate basis for establishing the actual remediation schedule. At this time, there are too many uncertainties regarding all aspects of the alternative (i.e., design, construction times, retrieval, ISTD treatment, grouting production rates) to estimate a schedule. Past experience demonstrated that years could be needed to obtain approval of a design or safety analysis for operations as simple as probing. Delays caused by obtaining approval internally, from DOE, or the regulatory agencies cannot be estimated at this time.

A risk associated with the cover system is any situation that results in losing using a primary borrow source located close to the site. The largest quantity of material needed for the cover system is silt loam. For this alternative, it is assumed that sufficient quantities of silt loam will be available from Spreading Area B, located near the site. If this source is lacking in capacity or otherwise unavailable, the nearest alternative sources are the Ryegrass Flats and the WRRTF borrow areas. Ryegrass Flats is 12 mi from the site and the WRRTF borrow area is 34 mi. The haul distance from Spreading Area A is 1.5 mi. Increased haul distances could result in a significant increase in the construction schedule and cost of materials.

VII. TABLES:

Table 1. Estimated production rates for in situ grouting.

Area	Size	Production Rate	Rig Machine Days
TRU pits	14.5 acres	1,571 hours/acre	2,279
TRU trenches	1.8 acres	1,571 hours/acre	283
Other COC trench areas	1.5 acre	1,571 hours/acre	236
Soil vault rows	650 vaults	1.9 hours/vault	102
Foundation stabilization	9.8 acres	390 hours/acre	128

COC = contaminant of concern

Table 2. Estimated grout volume.

Large Areas	Surface Area (ft^2)	Acres	Grout (yd^3)
TRU pits	663,974	15	203,280
TRU trenches	86,555	2	27,104

TRU = transuranic

Table 3. Summary of remedial design costs as percentages of capital and operating costs.

Technology	Percentage of Capital and Operating Costs
Capping (cover systems)	6
In situ thermal desorption	8
In situ grouting	8
Pad A retrieval and disposal	10

Table 4. Example feasibility study-level scope contingency percentages.

Remedial Technology	Scope Contingency (%)
Soil excavation	15 to 55
Synthetic cap	10 to 20
Clay cap	5 to 10
Surface grading and diking	5 to 10
Revegetation	5 to 10

Table 5. Summary of contingency costs as percentages of capital costs.

	Percent of Capital Cost		
Remedial Technology	Scope Contingency	Bid Contingency	Total Contingency
Capping	15	10	25
In situ grouting	20	15	35
In situ thermal desorption	25	25	50
Pad A retrieval and disposal	25	20	45

Table 6. In situ grouting—design and construction.

Activity Description	Estimated Duration
Borrow source investigation	1 year
Grout formulation and field testing	1 year (overlaps borrow source inv. by 1 year)
Remedial design and procurement	1.5 years (overlaps testing by 0.5 year)
Readiness assessment	1 year (no overlap with design)
Mobilization	0.5 year (no overlap with readiness assessment)
TRU pit grouting	152 weeks (no overlap with mobilization)
TRU trench grouting	19 weeks (no overlap with pit grouting)
Activation and fission trench area grouting	16 weeks (no overlap with trench grouting)
Soil vault row grouting	7 weeks (no overlap with trench grouting)
Foundation stabilization grouting	26 weeks (overlaps with C-14 area grouting)
Pad A retrieval and disposal	2 years (overlaps with grouting activities)
In situ thermal desorption	1 year (overlaps with grouting activities)
Earthen fill placement	2 years (overlaps with grouting activities)
Gas gravel, asphalt, drainage, and filter layers	2 years (overlaps grading fill placement by 1 year)
Placement of remaining layers	1 year (overlaps asphalt and other layers by 0.5 year)
Vegetation establishment	2 years (no overlap with placement of remaining layers)

TRU = transuranic

Table 7. Identification of in situ grouting process areas and necessary pretreatment, treatment, and posttreatment implementation steps.

Process Area	Pretreatment	Treatment	Posttreatment
TRU pits	Pretreat areas with organic oil content >12 wt% (approximately 1 acre) using low-temperature vapor extraction or oxidizing grout solutions.	ISG of waste zone to mix grout, waste, and interstitial soil into large monoliths. Grout designed to be low permeability and chemically reactive to immobilize COCs.	Construct low-permeability cap to minimize infiltration and to be consistent with other SDA areas.
TRU trenches		ISG of waste zone to mix grout, waste, and interstitial soil into large monoliths. Grout designed to be low permeability and chemically reactive to immobilize COCs.	Construct low-permeability cap to minimize infiltration and to be consistent with other SDA areas.
Activation and fission product waste areas		ISG of waste zone to mix grout, waste, and interstitial soil into large monoliths. Grout designed to be low permeability and chemically reactive to immobilize C-14.	Construct low-permeability cap to minimize infiltration and to be consistent with other SDA areas.
Soil vaults 344 large vaults (27-in. radius) 298 small vaults (9-in. radius)		ISG around and in soil vaults to encapsulate waste objects. Use cementitious grouts to minimize the corrosion of activated metal waste and bind radioactive fission products into the grout matrix.	Construct low-permeability cap to minimize infiltration and for consistency with other SDA areas.
Pad A	Retrieve waste containers from Pad A and segregate nitrate salt drums from other waste streams.	Stabilize nitrate salts ex situ with polyethylene or polysiloxane grout. Stabilize uranium waste ex situ with cementitious grout. Macroencapsulate debris waste with polyethylene.	Dispose of stabilized nitrate and uranium waste onsite. Dispose of macroencapsulated debris waste onsite.
Remaining pits and trench areas		ISG using low-permeability grout to fill void space and minimize subsidence.	Construct low-permeability cap to minimize infiltration and to be consistent with other SDA areas.

COC = contaminant of concern
ISG = in situ grouting
SDA = Subsurface Disposal Area

Table 8. Distances and sources of borrow materials for the modified Resource Conservation and Recovery Act Subtitle C cover system.

Material	Issue	One-Way Haul Distance	Source
Top soil	This material will consist of organic silt loam and will be used to construct a topsoil layer to support vegetation on top of the cover system.	1.5 mi	This material is assumed to be unprocessed organic silt loam derived from Spreading Area B.
Silt loam	This material will be used to construct a number of the layers within the cover system including the general site grading fill, perimeter berm, and topsoil.	1.5 mi	The majority of this material is expected to be unprocessed silt loam derived from Spreading Area B. Additional material is available from Ryegrass Flats (haul distance = 12 mi) and the WRRTF borrow area (haul distance = 34 mi). If permitted, some of this material could be excavated from Spreading Area B (haul distance = 1 mi).
Gravel	This material will be used for the gravel gas collection, drainage, and coarse filter layers within the cover system. Sufficient quantities of good structural gravel and fines materials are available.	2.5 mi	This material is assumed to be processed gravel derived from the Borax Gravel Pit.
Sand	This material will be used for the fine filter layers within the cover system. There are no identified bank run borrow areas available within the INEEL boundary.	45 mi	This material is assumed to be processed sand derived from an off=site borrow source.
Riprap	Riprap will be used for erosion control. The majority of the mined riprap material at the INEEL has been used for other remedial actions at the INEEL.	5 mi	This material is assumed to be processed material mined from a basalt outcropping identified 5 mi from the site, directly west of the RWMC and just outside the Big Lost River System.
Coarse fractured basalt	This material will be used for erosion control. The majority of the mined coarse fractured basalt material at the INEEL has been used for other remedial actions at the INEEL.	5 mi	This material is assumed to be processed material mined from a basalt outcropping identified 5 mi from the site, directly west of the RWMC and just outside the Big Lost River System.

RWMC = Radioactive Waste Management Complex
WRRTF = Water Reactor Research Test Facility

Table 9. Modified Resource Conservation and Recovery Act Subtitle C cover system design layers, thickness, and volume.

Layer	Thickness	Approximate Volume[a]	Material Description
Topsoil with gravel	20 in.	296,000 CCY	Processed silt loam topsoil with pea gravel admixture from Spreading Area B.
Compacted topsoil	20 in.	296,000 CCY	Unprocessed silt loam topsoil from Spreading Area B.
Sand filter layer	6 in.	89,000 CCY	Processed sand from off-Site borrow source.
Gravel filter layer	6 in.	89,000 CCY	Unprocessed gravel from the Borax Gravel Pit.
Lateral drainage layer	6 in.	89,000 CCY	Processed gravel from the Borax Gravel Pit.
Low permeability asphalt layer	6 in.	89,000 CCY	Asphalt from an off-Site source in Idaho Falls.
Asphalt base course	4 in.	59,000 CCY	Asphalt base course from an off-Site source in Idaho Falls.
Gravel gas collection layer	6 in.	89,000 CCY	Processed gravel from the Borax Gravel Pit.
Grading fill	120 in.	1,694,000 CCY	Unprocessed silt loam from Spreading Area B.
Fine filter	12 in.	6,000 CCY	Processed sand from off-Site borrow source for cover system toe armor; 16-ft long; 1-ft thick; 10,000-ft perimeter; 2.5H:1V side slopes.
Coarse filter	12 in.	6,000 CCY	Processed gravel from Borax Pit for cover system toe armor; 16-ft long; 1-ft thick; 10,000-ft perimeter; 2.5H:1V side slopes.
Coarse fractured basalt	12 in.	6,000 CCY	Processed basalt mined from an INEEL site for cover system toe armor; 16-ft long; 1-ft thick; 10,000-ft perimeter; 2.5H:1.V
Riprap	36 in.	18,000 CCY	Processed basalt mined from an INEEL site for cover system toe armor; 16-ft long; 3-ft thick; 10,000-ft perimeter; 2.5H:1V.
Perimeter berm	NA	244,200 CCY	Unprocessed silt loam from Spreading Area A; berm average 6.5-ft high; 100-ft wide; 10,000-ft perimeter; 2H:1V.

a. This table provides estimated in-place volumes rounded to the nearest 100 CCY.
CCY = compacted cubic yard

VIII. REFERENCES:

Armstrong, Aran T., Daniel A. Arrenholz, and Jerry R. Weidner, 2002, *Evaluation of In Situ Grouting for Operable Unit 7-13/14*, INEEL/EXT-01-00278, Rev. 0, Idaho National Engineering and Environmental Laboratory, CH2MHILL and North Wind Environmental for Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

Loomis, Guy G., Andrew P. Zdinak, and Carolyn W. Bishop, 1997, *Innovative Subsurface Stabilization Project—Final Report (Revision 1)*, INEL-96/0439, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE IN SITU GROUTING ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
FFA/CO MANAGEMENT AND OVERSIGHT											
WAG 7 Management (16-Years)											
Coordination/Oversight Tech Support - 1.0 FTE/YR		NA			32,000	HR	$ 93	$ 2,967,040			$ 2,967,040
Coordination with Agency Participants - 0.5 FTE/YR		NA			16,000	HR	$ 93	$ 1,483,520			$ 1,483,520
Environmental Engineering - 1.0 FTE/YR		NA			32,000	HR	$ 76	$ 2,421,440			$ 2,421,440
Cost and Schedule Control - 2.0 FTE/YR		NA			64,000	HR	$ 59	$ 3,768,960			$ 3,768,960
Regulatory Compliance - 1.0 FTE/YR		NA			32,000	HR	$ 79	$ 2,528,320			$ 2,528,320
Quarterly and Annual Reviews - 1.0 FTE/YR		NA			32,000	HR	$ 73	$ 2,325,760			$ 2,325,760
Audit Preparation and Coordination - 0.5 FTE/YR		NA			16,000	HR	$ 79	$ 1,264,160			$ 1,264,160
Health and Safety Coordination/Training - 2.0 FTE/YR		NA			64,000	HR	$ 62	$ 3,988,480			$ 3,988,480
Annual O&M Reports - 0.5 FTE/YR		NA			16,000	HR	$ 79	$ 1,256,640			$ 1,256,640
Attorney/Legal Fees. 0.3 FTE/YR		NA			9,600	HR	$ 150	$ 1,440,000			$ 1,440,000
Allocation for Other Direct Costs (ODCs) - 10% of Total Labor		NA								$ 2,200,432	$ 2,200,432
TOTAL COST - FFA/CO Management and Oversight											$ 25,845,000
Construction Management											
Construction Management (@ 6% of RA Costs)	6%	NA			1	LS	$ 39,442,800	$ 39,442,800			$ 39,442,800
General Conditions (@ 1.25% of RA Costs)	1.25%	NA			1	LS	$ 8,217,250	$ 8,217,250			$ 8,217,250
Health and Safety Equipment Allocation (@ 0.25% of RA Costs)	0.25%	NA			1	LS	$ 1,643,450	$ 1,643,450			$ 1,643,450
Medical Monitoring/Surveillance/Air Monitoring (@ 0.10% of RA Costs)	0.10%	NA			1	LS	$ 657,380	$ 657,380			$ 657,380
TOTAL COST - Construction Management											$ 49,961,000
TREATABILITY STUDIES											
Treatment Treatability Studies, ISG/ISTD (@ 5% of Phase 1 ISG and ISTD)	5%	NA			1	LS	$ 18,245,750	$ 18,245,750			$ 18,245,750
TOTAL COST - Treatability Studies											$ 18,246,000
REMEDIAL DESIGN AND REMEDIAL ACTION PLANS/REPORTS											
ISTD RD/RA Workplan (@ 8% of ISTD Capital/Operation)	8%	NA			1	LS	$ 2,202,560	$ 2,202,560			$ 2,202,560
PAD (A) Excavation RD/RA Workplan (@ 10% of PAD A Capital/Operations)	10%	NA			1	LS	$ 11,004,800	$ 11,004,800			$ 11,004,800
GROUTING RD/RA Workplan (@ 8% of ISG AND FDN GROUTINGCapital/Operations)	8%	NA			1	LS	$ 26,990,640	$ 26,990,640			$ 26,990,640
Surface Barrier RD/RA Workplan (@ 6% of Barrier Construction)	6%	NA			1	LS	$ 2,682,300	$ 2,682,300			$ 2,682,300
Readiness Assessment (@ 1.5% of RA)	1.5%	NA			1	LS	$ 9,860,700	$ 9,860,700			$ 9,860,700
Remedial Action Report					5,000	HR	$ 76	$ 378,350			$ 378,350
TOTAL COST - Remedial Design											53,119,000

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE
FOR THE IN SITU GROUTING ALTERNATIVE
(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: IN SITU GROUTING (ISG) ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/25/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
REMEDIAL ACTION											
ISTD APPLICATION FOR VOC REMOVAL (1 acre)											
Capital Equipment Costs											
ISTD Control Trailer		6	EA	$ 325,000	NA				$ 1,950,000		$ 1,950,000
ISTD Off-Gas Treatment		6	EA	$ 250,000	NA				$ 1,500,000		$ 1,500,000
ISTD Off-Gas Treatment Support (Chillers)		6	EA	$ 725,000	NA				$ 4,350,000		$ 4,350,000
ISTD Capital Costs (Assume 6-ISTD Systems Are Required)		1	LS	$ 5,256,620	NA				$ 5,256,620		$ 5,256,620
Electrical Power Supply/Overhead Powerline H-Frame		3	MI	$ 375,000	NA				$ 1,125,000		$ 1,125,000
Electrical Substation/Transformers for Site Distribution		2	EA	$ 125,000	NA				$ 250,000		$ 250,000
Operation Treatment/Deposal Costs											
ISTD Operational Costs (per acre)		1	AC	$ 153,103	1	AC	$ 4,030,658	$ 4,030,658	$ 153,103		$ 4,183,761
Power Consumption/Utilities										$ 460,000	$ 460,000
ISTD Secondary Waste Disposal										$ 2,500,000	$ 2,500,000
Installation/Pre-Operational Set-up/Testing (Percentage of Total Capital Costs)	10.0%	NA			1	LS	$ 1,458,472	$ 1,458,472			$ 1,458,472
Back-up Generators (Diesel Powered)		2	EA	$ 137,500					$ 275,000		$ 275,000
Repair/Maintenance/Spare Parts (Percentage of Operating/Treatment Costs)	25.0%	NA			1	LS	1,007,665	$ 1,007,665			$ 1,007,665
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 486,330	NA				$ 486,330		$ 486,330
D&D Cost for Equipment (Percentage of Capital Equipment)	10.0%	NA			NA					$ 1,443,162	$ 1,443,162
INEEL Site-Specific Training/Work Order Requirements	6.0%				1	LS	746,441.04	$ 746,441			$ 746,441
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 539,849	$ 539,849
Subtotal											**$ 27,532,000**
PAD A EXCAVATION											
Capital Equipment/Disposal Bins		1	LS	$ 7,620,000	NA				$ 7,620,000		$ 7,620,000
Containment Building											
Building; RCS Materials and Erection		94,300	SF	$ 350	NA				$ 33,005,000		$ 33,005,000
Building; Radiological, Fire Protection, CCTV, HVAC		94,300	SF	$ 250	NA				$ 23,575,000		$ 23,575,000
Weather Enclosure (Assume 10% Larger Footprint)		103,730	SF	$ 65	NA				$ 6,742,450		$ 6,742,450
Over head Crane, Monitors, Misters		1	LS	$ 350,000	NA				$ 350,000		$ 350,000
Building Operations Costs		20	MO	$ 130,208	NA				$ 2,604,160		$ 2,604,160
Treatment Building											
Building Construction		10,000	SF	$ 225	NA				$ 2,250,000		$ 2,250,000
Solidfication System (100 drums/day) (Pugmill)		1	EA	$ 11,900,000					$ 11,900,000		$ 11,900,000
Overburden Soil Removal/Stockpile		12,110	CY	$ 5	NA				$ 57,765		$ 57,765
PAD A Excavation and Waste Handling (2-years)		300	CD	$ 15,368	300	CD	$ 10,920	$ 3,276,000	$ 4,610,400		$ 7,886,400
Equipment Repair and Maintenance (10%)	10%	1	LS	$ 461,040					$ 461,040		$ 461,040
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 549,283	NA				$ 549,283		$ 549,283
D&D Cost for Equipment	10.0%	NA			NA					$ 8,544,245	$ 8,544,245
Characterize TRU wastes for WIPP disposal (per drum)		20	EA	$ 1,500					$ 30,000		$ 30,000
INEEL Site-Specific Training/Work Order Requirements		NA			1	LS	$2,314,844	$ 2,314,844			$ 2,314,844
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 2,157,804	$ 2,157,804
Subtotal											**$ 110,048,000**

Prepared by CH2M HILL

3/21/2002

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE FOR THE IN SITU GROUTING ALTERNATIVE

(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: IN SITU GROUTING (ISG) ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/25/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
GROUTING											
BUILDINGS AND EQUIPMENT											
Administrative Buildings (Lunch Room and Change Room)		10,000	SF	$ 95	NA				$ 950,000		$ 950,000
Equipment Maintenance/Storage Area		10,000	SF	$ 175	NA				$ 1,750,000		$ 1,750,000
Decontamintation Area		5,000	SF	$ 150	NA				$ 750,000		$ 750,000
EQUIPMENT COST											
Capital Cost - Batch Plant, Vehicles, Drill Rigs		1	LS	$ 8,326,000.0	NA				$ 8,326,000		$ 8,326,000
Mobilize/Erect Weather Structure Grouting Operations		2	EA	$ 750,198.0	NA				$ 1,500,396		$ 1,500,396
HEPA Filtration System/Lighting/Redundant Systems		2	EA	$ 2,147,448.0	NA				$ 4,294,896		$ 4,294,896
Back-up Generators (Diesel Powered)		2	EA	$ 375,000.0	NA				$ 750,000		$ 750,000
Building Foundation Construction		30,277	LF	$ 561.0	NA				$ 16,985,397		$ 16,985,397
Bridge Crane/Control System		3	EA	$ 670,000.0	NA				$ 2,010,000		$ 2,010,000
Bridge Crane/Control System/Modify and Install		NA			1	LS	$ 1,005,000	$ 1,005,000			$ 1,005,000
D&D Cost for Equipment/Enclosures	10.0%	NA			NA					$ 3,386,669	$ 3,386,669
INEEL Site-Specific Training/Work Order Requirements		NA			1	LS	$ 873,100.5	$ 873,101			$ 873,101
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 782,629	$ 782,629
Subtotal											**$ 43,364,000**
PRE-CONSTRUCTION ACTIVITIES											
Plug and Abandon (P&A) Existing GW Wells		NA			71	EA	$ 15,000	$ 1,065,000		$ 1,775,000	$ 2,840,000
Install New Nested GW Wells Outside Perimeter of Cap (Drilling Sub and Equipment)		NA			24	EA	$ 50,000	$ 1,200,000		$ 3,000,000	$ 4,200,000
Construct Rail Spur for Bulk Grout Delivery/Storage		1	LS	$ 1,200,000					$ 1,200,000		$ 1,200,000
INEEL Site-Specific Training/Work Order Requirements					1	LS	$ 164,700	$ 164,700			$ 164,700
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 168,094	$ 168,094
Subtotal											**$ 8,573,000**
OPERATIONS											
5-Foot Thick Cover Material (Initial Site Grading)		130,000	CCY	$ 10	NA				$ 1,300,000		$ 1,300,000
Grout Activation/Fission Product Trench Areas		79	CD	$ 181,314	79	CD	$ 40,902	$ 3,231,258	$ 14,323,806		$ 17,555,064
Grout TRU Trenches		94	CD	$ 181,314	94	CD	$ 40,902	$ 3,858,422	$ 17,103,954		$ 20,962,376
Grout TRU Pits		760	CD	$ 181,314	760	CD	$ 40,902	$ 31,071,886	$ 137,738,202		$ 168,810,088
Grout SVRs		34	CD	$ 181,314	34	CD	$ 40,902	$ 1,390,668	$ 6,164,676		$ 7,555,344
Grout Rig Decontamination		3	EA	$ 2,125,800	NA				$ 6,377,400		$ 6,377,400
HEPA Filtration System Operation		2	YR	$ 2,000,000	NA				$ 4,000,000		$ 4,000,000
Repair/Maintenance/Spare Parts (Percentage of Operating/Treatment Costs)	10.0%	1	LS	$ 19,977,770	NA				$ 19,977,770		$ 19,977,770
Verification Testing Geophysical Survey		10	MO	$ 94,588	2,500	HR	$ 76	$ 189,175	$ 945,875		$ 1,135,050
Foundation Stabilization Grouting (Other Trenches, 98-MD)		128	CD	$ 99,763	128	CD	$ 40,902	$ 5,235,456	$ 12,769,664		$ 18,005,120
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 6,175,798	NA				$ 6,175,798		$ 6,175,798
INEEL Site-Specific Training/Work Order Requirements		NA			1	LS	$ 7,995,444	$ 7,995,444			$ 7,995,444
Subcontractor Insurance/Bonds	2.0%	NA			NA					$ 5,596,989	$ 5,596,989
Subtotal											**$ 285,446,000**
SURFACE BARRIER											
PRECONSTRUCTION ACTIVITIES											
Borrow Source Site Investigation		1	LS	$ 250,000	NA				$ 250,000		$ 250,000
Spreading Area "B" 404 Permit Application (6-months)		1	LS	$ 200,000	NA				$ 200,000		$ 200,000
Surface Water Controls/Soil Erosion Sediment Control Features		1	LS	$ 250,000	NA				$ 250,000		$ 250,000
Site Preparation: Clear, Grub & Grade		125	AC	$ 3,800	NA				$ 475,000		$ 475,000
Construct 2-mile Haul Road from Borrow to Site (Stone Road)		2	MI	$ 500,000	NA				$ 1,000,000		$ 1,000,000
Install/Develop GW Wells for Compaction Water		3	EA	$ 250,000	NA				$ 750,000		$ 750,000
Subtotal											**$ 2,925,000**

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE
FOR THE IN SITU GROUTING ALTERNATIVE
(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: IN SITU GROUTING (ISG) ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/25/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
CONSTRUCTION - MODIFIED RCRA SUBTITLE "C" CAP											
Pea Gravel Admixture with Topsoil 20-inches		296,000	CCY	$ 6	NA				$ 1,773,040		$ 1,773,040
Compacted Silt Loam (Topsoil) 20-inches		296,000	CCY	$ 5	NA				$ 1,411,920		$ 1,411,920
Sand Filter Layer 6-inches		89,000	CCY	$ 25	NA				$ 2,225,000		$ 2,225,000
Gravel Filter Layer 6-inches		89,000	CCY	$ 10	NA				$ 890,000		$ 890,000
Lateral Drainage Layer 6-inches		89,000	CCY	$ 10	NA				$ 890,000		$ 890,000
Low-Perm Asphalt 6-inches		89,000	CCY	$ 19	NA				$ 1,646,500		$ 1,646,500
Asphalt Base Course 4-inches		59,000	CCY	$ 19	NA				$ 1,091,500		$ 1,091,500
Gravel Gas Collection Layer, 6-inches		89,000	CCY	$ 10	NA				$ 890,000		$ 890,000
Fine Filter - Sideslopes, 12-inches		6,000	CCY	$ 25	NA				$ 150,000		$ 150,000
Coarse Filter - Sideslopes, 12-inches		6,000	CCY	$ 10	NA				$ 60,000		$ 60,000
Sideslope Rip-Rap 12-inches		6,000	CCY	$ 40	NA				$ 240,000		$ 240,000
Rip-Rap, Sideslope , 36-inches		18,000	CCY	$ 40	NA				$ 720,000		$ 720,000
Grading Fill, 10-ft Thick Average (Less post ISG decon fill)		1,564,000	CCY	$ 5	NA				$ 7,460,280		$ 7,460,280
Perimeter Berm		244,200	CCY	$ 5	NA				$ 1,164,834		$ 1,164,834
					NA						
Install (37) New Lysimeters and Cap Penetrations		37	EA	$ 131,756	NA				$ 4,874,972		$ 4,874,972
OCVZ System Relocation/Well Extension		1	LS	$ 300,000	NA				$ 300,000		$ 300,000
Lab Geotechnical Testing/Compaction		40	MO	$ 50,000	NA				$ 2,000,000		$ 2,000,000
Filed Geotechnical Testing/Compaction		40	MO	$ 90,000	NA				$ 3,600,000		$ 3,600,000
Surveying/Grade Control		40	MO	$ 65,000	NA				$ 2,600,000		$ 2,600,000
Third-Party Independent CQA Testing/Certification		40	MO	$ 75,000	NA				$ 3,000,000		$ 3,000,000
Hydroseeding/Mulching (Re-seeding Included)		125	AC	$ 2,750	NA				$ 343,750		$ 343,750
											$ -
Seasonal Shutdown/Re-Mobilization		3	EA	$ 500,000	NA				$ 1,500,000		$ 1,500,000
Mobilization and Demobilization (2% of Total Cost)	2.0%	1	LS	$ 805,136	NA				$ 805,136		$ 805,136
INEEL Site-Specific Training/Work Order Requirements					1	LS	$ 1,021,486.4	$ 1,021,486.4			$ 1,021,486
Subcontractor Insurance/Bonds	2.0%				NA					$ 871,668	$ 871,668
Pre-Final Inspection Report, Phase I					1	LS	$ 250,000.0	$ 250,000.0			$ 250,000
Subtotal											**$ 41,780,000**
Subtotal Subcontractor Directs - Remedial Action											**$ 519,668,000**
Subcontractor Overhead	15.0%										$ 77,950,200
Subcontractor Profit	10.0%										$ 59,761,820
TOTAL COST OF REMEDIAL ACTION											**$ 657,380,000**
TOTAL CAPITAL COST - Remedial Action Contracts											**$ 804,351,000**
POST-REMEDIAL ACTION OPERATIONS (100 YEAR DURATION)											
INSTITUTIONAL CONTROLS FOR 100 YEARS											
Install Permanent Markers/Survey		12	EA	$ 5,000	NA				$ 60,000		$ 60,000
Replace Perimeter Security Fence		10,000	LF	$ 20	NA				$ 200,000		$ 200,000
Repair and Replace Perimeter Signs		1	LS	$ 10,000	NA				$ 10,000		$ 10,000
Subtotal											**$ 270,000**

OPERABLE UNIT 7-13/14 FEASIBILITY STUDY COST ESTIMATE
FOR THE IN SITU GROUTING ALTERNATIVE
(continued).

Project Title: WAG 7 OU 13/14 Feasibility Study

PROJECT: WAG 7, FS COST ESTIMATES
OU7-13/14 DRAFT COMPREHENSIVE FS
SUBJECT: IN SITU GROUTING (ISG) ALTERNATIVE
LOCATION: INEEL - RWMC

TYPE OF ESTIMATE: PLANNING

PREPARED BY: BKC
CHECKED BY: BS/LL
Reviewed/Updated: MAG 10/25/02

DESCRIPTION		MATERIAL/ EQUIP QTY	MATERIAL/ EQUIP UNIT	MATERIAL/ EQUIP COST PER UNIT	LABOR QTY	LABOR UNIT	LABOR RATE PER UNIT	TOTAL LABOR COST	TOTAL MATERIAL/ EQUIP COST	OTHER COST	TOTAL COST
COVER MAINTENANCE											
Cover Maintenance Cost - 100 Year Duration Annual Cap Maintenance Costs		100	YR	$ 75,000	NA				$ 7,500,000		$ 7,500,000
Subtotal											**$ 7,500,000**
SURVEILLANCE AND MONITORING											
Groundwater Monitoring: (16-wells)											
Groundwater Monitoring, Quarterly for 2 Years - (8-Sampling Events)		8	EVT	$ 1,000	8	EVT	$ 11,000	$ 88,000	$ 8,000	$ 854,936	$ 950,936
Groundwater Monitoring, Semi -Annually for 3 Years - (6-Sampling Events)		6	EVT	$ 1,000	6	EVT	$ 11,000	$ 66,000	$ 6,000	$ 641,202	$ 713,202
Groundwater Monitoring, Annually for 95 Years (95-Sampling Events)		95	EVT	$ 1,000	95	EVT	$ 11,000	$ 1,045,000	$ 95,000	$ 10,152,365	$ 11,292,365
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)		1	LS	$ 1,295,650	NA				$ 1,295,650		$ 1,295,650
Vadose Zone Monitoring:											
Sample 37 Lysimeters 1 Time per Year in Late Spring		100	EVT	$ 1,000	100	EVT	$ 17,875	$ 1,787,500	$ 100,000	$ 2,671,700	$ 4,559,200
Sample & Analyze 20 Vapor Ports 4 Times per Year for 5 Years		20	EVT	$ 1,000	20	EVT	$ 27,500	$ 550,000	$ 20,000	$ 140,000	$ 710,000
Sample & Analyze 20 Vapor Ports 1 Time per Year thereafter		95	EVT	$ 1,000	95	EVT	$ 27,500	$ 2,612,500	$ 95,000	$ 665,000	$ 3,372,500
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)		1	LS	$ 864,170	NA				$ 864,170		$ 864,170
Surface Water Monitoring:											
Collect Sample from 2 Points 2 Times Every 5 Years (20 Sample Events)		20	EVT	100	20	EVT	$ 1,375.00	$ 27,500.00	$ 2,000	$ 320,660	$ 350,160
Vegetation Monitoring:											
1 Inspection per Year in Early Fall for 5 years		NA			5	EVT	$ 1,100	$ 5,500			$ 5,500
Re-seed 10 Acres Each Year for 5 Years (50 Acres Total)		50	AC	$ 15,000	NA				$ 750,000		$ 750,000
1 Inspection Every 5th Year in Early Fall Thereafter for 95 Years		NA			19	EVT	$ 1,100	$ 20,900			$ 20,900
Re-seed 10 Acres Every 5 Years		19	EVT	$ 15,000	NA				$ 285,000		$ 285,000
Air Monitoring (Radiological/Organic):											
Monitor 4 Existing CAMs		100	EVT	$ 1,000	1	LS	$ 2,200	$ 220,000	$ 100,000	$ 15,300	$ 335,300
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)		1	LS	$ 33,530					$ 33,530		$ 33,530
Perimeter Radiological Monitoring GPS with NaI Detector											
2 People, 1-Time per Year, 2 Days in Summer with Hummer & GPS		100	YR	$ 500	100	YR	$ 2,200	$ 220,000	$ 50,000		$ 270,000
Data Interpretation/Plot Data		100	YR	$ 750	100	YR	$ 2,500	$ 250,000	$ 75,000		$ 325,000
Replacement Parts/Equipment Costs (Assume 10% of Total Costs)		1	LS	$ 59,500	NA				$ 59,500		$ 59,500
Biological Monitoring:											
2 People 2-Times, First 5-Years for Intrusion Monitoring					2	EVT	$ 1,100	$ 2,200			$ 2,200
2 People 1-Time, Every 5th Year thereafter for 95 years					19	EVT	$ 1,100	$ 20,900			$ 20,900
Subtotal											**$ 26,216,000**
Subtotal Surveillance and Monitoring (Sampling & Monitoring Activities)											**$ 33,986,000**
WAG 7 MANAGEMENT											
WAG 7 Management (@ 5% of other post-RA operations costs)	5%				1	LS	$ 1,699,300	$ 1,699,300			$ 1,699,300
Annual Data Summary Report (100 reports @ 200 hrs/report)					20,000	HR	75.00	$ 1,500,000			$ 1,500,000
WAG-Wide RA 5 Year Reviews for 100 Years @ 600 hrs/review					12,000	HR	$ 75	$ 900,000			$ 900,000
Subtotal											**$ 4,099,300**
TOTAL COST - Post-Remedial Action Operations (100 Year Duration)											**$ 38,085,300**